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Understanding design creativity through pretense ability

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Abstract

In cognitive psychology literature design activity is commonly described as a creative problem-solving process. This process is a transformative way of thinking, involving re-imagining the problem as set of possible states and creating alternative solutions to achieve the requirements of the problem space. Creative thinking is the main skill that facilitates the design process. Pretend play, in the context of developmental theories, is limited to early childhood and seen as the foundation of adult creativity. It is associated with the notion of affordances which is related to the "seeing as if" ability. This study aims to identify similar cognitive processes between designers' creative problem-solving and pretense ability and uses a designing activity to present how pretense, seeing as if, may exist in adulthood. To identify the features and similarities of childhood pretense and design process, first a comparative scheme was conceptualized and illustrated. Second, based on our "affordance-based pretense framework of design creativity," an experiment was designed to examine the relation of pretense (acting as if) ability to creativity measures. 52 participants completed a series of experimental tasks including a creative mental synthesis task and an alternate use test (AUT). Both Kruskal-Wallis H and Mann-Whitney U Tests showed that participants performing affordance-based pretense framework of design creativity tasks received higher creativity scores which suggests that exhibited higher degrees of creativity in terms of being able to see affordances in their object forms.

Keywords
Affordances, Creativity, Design, Design process, Pretend play.

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1. Introduction

The ability to think creatively is an essential function for human cognition. It enables individuals to think divergently and to make unexpected connections while finding alternative solutions to problems (Finke, Ward and Smith, 1992; Scott, Mumford and Leritz, 2004; Wang, Peck and Chern, 2010; Anoiko, 2011; Sawyer, 2012). From the perspective of problem-solving theory, while creativity enables an individual to find novel solutions to the problems, it also facilitates both defining a unique problem space as well as re-defining the problem. Design is most commonly defined as a creative problem-solving process (Simon, 1969; Thomas and Carroll, 1979; Dorst & Cross, 2001; Hasirci & Demirkan, 2007; Lawson & Dorst, 2009) and designers deal with ill-defined or wicked problems (Rittel & Webber, 1973; Cross, 1982). The ill-defined and complex nature of design problems require the ability of creative thinking since they cannot be solved using routine problem-solving procedures (Gero, 1996). As the central concern of design activity is being creative, enhancing creativity is a significant issue in design research (Lawson, 2005; Cross, 2006).

Creative abilities, including such as ideational fluency, novel ways of thinking, flexibility of the mind, and the ability to analyze and synthesize (Guilford, 1950), which are characteristics of creative people are also essential characteristics of designers. Enhancing the creative problem-solving process in design is associated with improving flexible and divergent thinking skills. These skills enable designers to break away from set patterns of thinking and formulate novel solutions to design problems. In a different area of creativity research, Russ (2014) states that many of these processes in creative production occur in the pretend play of children.

Pretend play, in the context of developmental theories, is limited to early childhood and is considered to be the foundation of adult creativity. In pretend play, children think divergently to see unique ideas and combine them in a new context of play as a key component of creativity (Singer & Singer, 1990). Pretend play or the pretense ability can be seen as a kind of acting *as if* something is the case when it is not (Leslie, 1987). As Dansky (1999) argues, adopting the "*as if*" frame in play may open the door to solving real world problems while enabling one to play with ideas and many different possibilities. Children deal with real-world issues while playing. The pretend play of children could be considered as an example of everyday creativity - in other words, little-c creativity (Zook, Magerko and Riedl, 2011; Russ, 2014). Accordingly, children can simulate and transform the routine events of everyday life in pretend play and find new possibilities while treating one object *as if* it is another, e.g., using a banana *as if* it is a telephone (Dansky, 1999).

Pretense, pretend play or acting *as if* are also associated with the notion of affordance (Szokolsky, 2006; Rucińska, 2015). Children are aware of the affordances of different objects around them and explore their various action possibilities for their different kinds of play activities (Szokolsky, 2006). Rucińska (2015) explained pretense with an enactive account of pretend play, "seeing-affordances-in". Affordance is generally defined as the possibilities for actions (Gibson, 1979; Turvey, 1992; Norman, 2013; Rucińska, 2015; Glăveanu, 2016). In pretend play, children see new affordances (possibilities of action) of objects through interaction with them, which means that pretend play enables them to see beyond the known uses of objects in different contexts (Rucińska, 2015).

The seeing *as if* notion in pretense recalls the situated account of design process, as a sequence of seeing-moving-seeing cycles (Schön, 1983; Schön and Wiggins, 1992). According to the situated account of design problem depiction, similar to the pretense process, designers examine and interpret the design situation, construct it by setting the dimensions of the problem space, see it from multiple perspectives and create the moves to find solutions (Schön, 1983; Schön & Wiggins, 1992). Lawson and Dorst has described the see-move-see sequence of the designing process as "the art of seeing the design situation in multiple ways or seeing *as if*" (2009, p.26). While designing, searching for

the visual emergence of objects allows the designers to look at these emergent visual structures from different perspectives and discover different possibilities hidden within the structures (Finke, 1990). In the design process, it's important to see different actions' possibilities in objects considering the interaction between an object and its user who enables the action. As there is no single or optimal solution to a design problem, to find new possibilities, Picciuto and Carruthers (2014) claim that it's essential to be open to alternative ideas or behaviors and concurrently bypass more obvious ideas to see the other possibilities.

In pretense, children are open to seeing numerous possibilities and they go beyond conventional thinking. In the design process, the designer aims to reach this flexible way of thinking. While children pretend spontaneously, designers learn to do so in the design process by re-developing some set of skills.

This study is an example of basic research designed to contribute to the field of cognitive design studies by exploring the relationship between childhood pretense as an example of acting *as if* and designers' initial form-giving process. Designing ability is a very complex thinking process involving many cognitive functions. This study opens a new perspective which has not been previously associated with pretense ability and design process. It is proposed that children's pretend play shares similar cognitive function to designers' creative problem solving processes. The current paper, which is a portion of this broader study, describes the similarities between "design process" and "childhood pretense" and presents a conceptual framework linking them based on affordance theory (Turvey, 1992). Although some developmental theorists like Piaget (1962) and Vygotsky (1978) argue that imaginative or pretend play is peculiar to early childhood, this study hypothesizes that pretense is not limited to childhood, since acting *as if* has significant similarities with designers' initial designing process. Finke's (1990) Creative Mental Synthesis Task is used to simulate childhood pretense as a method for the current study.

In the first part of the paper, to identify the features and similarities of childhood pretense and design process, a comparative framework is conceptualized and illustrated. In the second part, an experiment was designed to assess the affordance-based pretense framework of design creativity with two different measures of creativity, an alternate uses test (AUT) and a creative mental synthesis test. To compare the findings in terms of creativity, the experiment was conducted both with design and non-design undergraduate students. The reason to conduct the experiment with design and non-design students was to compare the results of the creative mental synthesis task, which was designed conceptually as a simulation of whether the affordance-based pretense process is related to creativity. The results of the task were evaluated within the framework of affordance-based pretense-creativity relationship and then discussed in regard to early design process and pretense ability.

2. Pretense, imaginative thought and creativity

> "Caught between divinity and animality,
> between what is and what it might be,
> it is the child who mediates the
> human possibility"
> *(Kennedy, 2006, p. 5).*

Children's pretend play is a fascinating research area related to creativity and has gained considerable attention recently (Russ, 1996, 2004, 2014; Russ, Robins and Christiano, 1999; Carruthers, 2002; Picciuto & Carruthers, 2014, 2016). According to Carruthers (2002), childhood pretense is an exemplar of human creativity which is related to the imagination of possibilities. Russ claims that "pretend play is a vehicle for the expression of many processes that are important in creative production" (2016, p.22). She also suggests there are many cognitive and affective processes which are related to creativity that occur in pretend play as divergent thinking, broad associations, cognitive flexibility, perspective taking, insight and problem solving, etc. (2014).

As a distinguishing activity of children, around the middle of their second year of age, all healthy children

commonly engage in pretense as a form of play (Carruthers, 2002; Picciuto & Carruthers, 2016). Perner's description of pretense is "knowingly acting *as if* the world were different than it really is" (Perner, 1991, p.43). In acting *as if* the object is another, the pretend object supports the pretend act with substitution. Object substitution is a kind of pretend play in which playing with objects involves treating one object *as if* it is another and can be defined as the active, playful manipulation of objects (Bjorklund & Gardiner, 2011). In their episodes of play, children pretend that a banana is a telephone that they are talking with or pretend a rectangular block is a car or pour pretend "tea" from an empty plastic teapot, etc. Children's behavior is driven by their imagination which is a capacity for seeing the world in a way that is different from how it really is (Nielsen 2015). Seeing one object *as if* it is another imaginatively assists them in transforming a function from one object to another (Vygotsky, 2004). According to Lillard (2002), "pretense is an act of projective imagining" (p.104).

Carruthers (2002) indicates that pretend play and adult creativity share a common basis in supposition (imagining). Both include "essentially the same cognitive underpinnings—namely, a capacity to generate, and to reason with, novel suppositions or imaginary scenarios" (Carruthers, 2002, p.229). Imagination is also related to counterfactual reasoning. Counterfactual reasoning enables people to shift from perceiving the immediate environment to an alternative imagined perspective (Van Hoeck, Watson and Barbey, 2015). Weisberg & Gopnik argue that pretense and counterfactual reasoning both involve considering events that have not occurred yet and thinking about what would be the case if they had (2013). They share the same mechanism: disengaging with current reality, and making inferences about an alternative representation of reality (Weisberg and Gopnik, 2013). Counterfactual alternatives are created when "what if" or "if only" scenarios occur as possible alternatives to reality (Byrne, 2016). Likewise, reasoning about alternative scenarios is seen in the design process; designers deal with questions like what might be, could be and should be instead of what is, how and why (Lawson, 2005). Designers try to broaden the point of view to find possible solutions in design process. The possible solutions associate with "seeing-possibilities," in other words, "seeing-possible affordances" in the creative design process.

3. Seeing possibilities and discoveries in the design process: The affordance-based pretense framework of design creativity

The concept of affordance is first introduced by Gibson as follows, "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or for ill" (1979, p.127). The environment consists of affordances, which are action possibilities formed by the relationship between an agent and its environment (Gibson, 1979). Shotter (1983) finds Gibson's view to be static; they are in the environment waiting to be discovered by "finders." Affordances of an object can be seen as "the set of all potential human behaviors that an object might allow;" they are "context dependent action or manipulation possibilities" (Brown and Blessing, 2005).

From another perspective, Chemero (2003) suggests that affordances are not properties of the environment but they are affiliations between features of the environment and the abilities of organisms. Supporting this view, Nye and Silverman state that "affordances may be considered dyadic relationships between an object and agent" (p.179), which means having an existential relationship between an agent and an environment (Nye & Silverman, 2012). Affordances could be understood as opportunities for action which are relational and dispositional properties of the environment (Turvey 1992). Christensen (2005) mentions that the creative process is a search for the possibilities and impossibilities of the real-world and to be able to follow how something comes to be something else in creative development. It's essential to focus on subject-object interactions because, as

he clarifies, "creativity does not come into being out of nothing (ex nihilo), but is grounded in knowledge of the world and its possibilities" (Christensen, 2005, p.196).

The possibilities of the world are related with Currie's (2004) account of pretense which involves imaginative transformations and the capacity to view the world from another perspective: seeing one thing as another. Rucińska (2015) elaborated on Currie's (2004) perceptual seeing-in (or experiencing-in) view and presented the enactivist alternative account for pretense: "seeing-affordances-in" (or seeing possibilities of action in). According to Rucińska (2014), while in the course of pretend play, a child sees the affordances (possibilities of action) in new situations by interacting with the object. For example, a banana may afford various actions for a child in different contexts, as eating for breakfast, playing "phone" when held to an ear or playing "hat" when held on the head. An object may offer a variety of potential affordances to be realized in relation to the individual's intentions and a child can discover many new affordances of an object by using it in different ways (Heft, 1989). This process of discovery, which entails seeing potential affordances of the circumstances, is an essential part of design creativity, as it enables one to see alternative possible solutions to design problems. Designing is an activity that is supposed to lead to new possibilities and creativity is a central aspect in design research, design education and professional practice in design (Dorst, 2003; Cross, 2006; Howard, Culley and Dekoninck, 2008; Lawson & Dorst, 2009). While dealing with uncertainty in early design stages, designers need to dissolve existing beliefs, habits and assumptions and play with new possible ideas and embody them for the future world. The central concern of design is "the conception and realization of new things" (Cross, 2006). As creative problem-solving is an exercise of "seeing as," which involves looking at something we already know in a different way (Olteteanu, 2015), designers should consider these possibilities with "seeing as" rather than only focusing on the intended function of an object form.

Similar to Currie's "seeing as" account of pretense, Goldschmidt (1991) asserted that the designer is "seeing as" when he/she is using figural, or "gestalt" argumentation while "sketch-thinking" in the early stages of design process. Schön and Wiggins (1992) describe the "seeing" process as "the designer not only visually registers information but also constructs its meaning - identifies patterns and gives them meanings beyond themselves" and this process happens in the "reflective conversation with the materials of a design situation" (Schön, 1992). For designers, sketching is a way that enables them to externalize their thought into bodily engagement with the environment (Hinton, 2015, p.46). Verstijnen et al., (1998) suggests that spontaneous externalizations of mental images while sketching assist designers in overcoming limitations and making creative discoveries in visual imagery. When a designer sketches a new feature intending it to hold a spatial relation with existing sketch features, unintended spatial relations are automatically produced and, in turn, these unintended relations may be discovered unexpectedly by the designer (Suwa, Gero and Purcell, 2000).

The similarities between children's pretend play process and designers' form-search process in conceptual design phase, as this study hypothesized, are illustrated in Figure 1. The children's pretense process and the hypothesized pretense process in the initial form-search process in designing activity is schematized. The act of "phoning" is met with a banana, a matching form of a phone. Similarly, designers search for the affordances of forms for the intended acts as well as intended user behavior. This search process is hypothesized as childhood pretend play. Designers, like children, try to discover new action possibilities in different use contexts. Children and designers, both pretenders, try to switch between ideas as they look for affordances.

4. Experiment overview

In this study, it's hypothesized that pretense is not limited to childhood and children's pretense or acting *as if* ability has significant similarities with designers' form-search or form-giving in the

conceptual design phase. To verify the differences of pretending or acting *as if* ability of design and non-design students, and to measure this difference in the framework of creativity, the "pretense" process is simulated with a creative mental synthesis task. According to the proposed pretense framework of design creativity, to compare the "pretense" or "seeing-affordances-in" ability, the creative mental synthesis task of Finke (1990) was conducted with design and non-design students. Both student groups had experimental and control groups. The control group's task was held in 5 minutes. The experimental group's task had two stages and each stage was held in 5 minutes (in total 10 minutes). The sketching behavior was also observed during the sessions. The participants were informed with a consent form and a verbal brief. The procedure was identical for every participant.

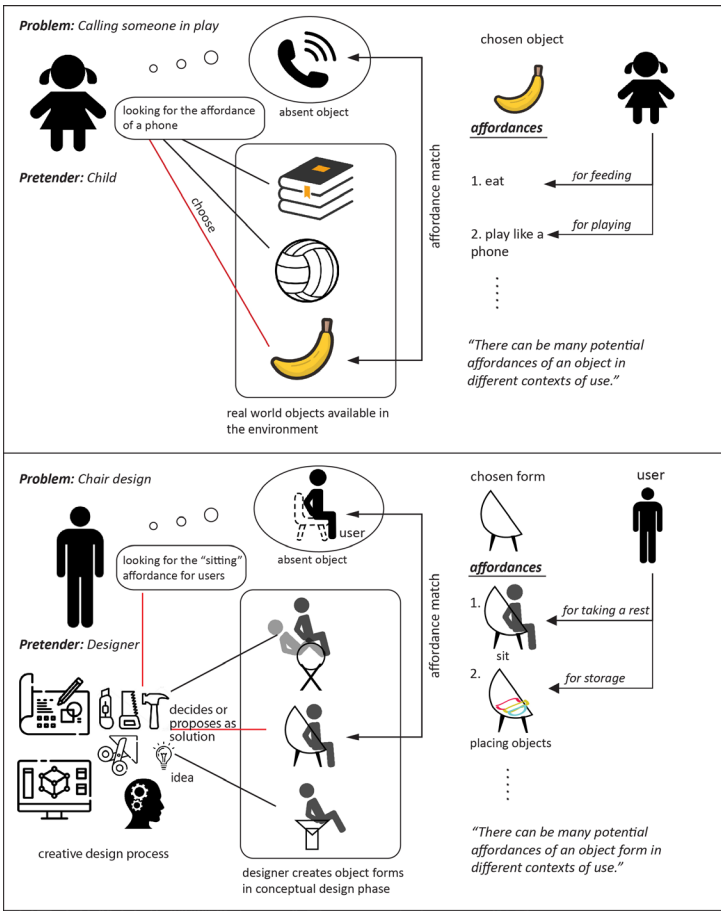


Figure 1. *Affordance-based pretense schema of form-search similarities of a child and a designer.*

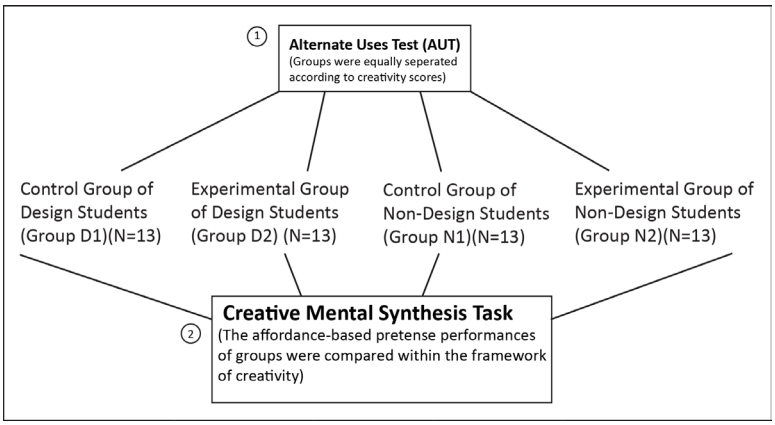


Figure 2. *The experiment overview.*

4.1. Participants

26 participants both from Design and Non-design undergraduate departments, totaling 52 third-year (junior) students participated in the experiment. The reason why non-design students were included was to eliminate the design-education effect on creativity measures. Before the experiment, all students were given an alternate uses test (AUT) and 52 sample participants were chosen according to AUT scores among 60 students. The groups were equally separated based on their AUT test results. The aim was to equalize the conditions for all the groups so their creativity level would not interfere with the results. They completed the experiment individually. All the task materials were provided by the experimenter.

4.2. Materials

Each of the 52 participants was given experimental materials which contained consent forms, alternate uses tests, procedure briefs and creative mental synthesis tasks.

The alternative (or unusual) uses test (AUT), created by J.P. Guilford in 1967, is a standard test of a measure of divergent thinking ability in which participants list alternative uses for common objects which can be used every day. The participants were given an A4 paper which includes five different objects' names and they were expected to write new and original uses for each one. The words "paper clip," "brick," "blanket," "barrel" "jar" were given in Turkish and participants produced original uses for these words.

In the creative mental synthesis task, participants were given A3 papers which include three of the 3D objects which were selected at random between fifteen objects, shown in Figure 3.

4.3 Procedure

The creative mental synthesis task

The creative mental synthesis task (Finke, 1990) is also known as "combination task." In this task, participants combine the given parts mentally and draw the final form. The task measures the ability to synthesize, which leads to the possibility of discovering new meanings from the combination of parts while creating a new whole.

The current experiment consisted of 4 groups (2 design student groups and 2 non-design student groups); each department had a control and experimental group. Before the experiment the participants received a document with instructions explaining the procedure of the experiment.

The control groups were given 5 minutes and the category name: "sitting unit" and then they combined the given parts so as to make an object that could reasonably be referred to as a "sitting unit" and drew the final form. On the other hand, the experimental groups spontaneously created object forms with the three parts in 5 minutes. After creating the forms, they were asked to interpret and draw one of the alternative forms to match the "sitting unit" category in 5 minutes. An example procedure schema of control groups and experimental groups is shown in Figure 4. The control group of design students was represented as Group D1; the experimental group of design students as Group D2; the control group of non-design students as Group N1; and the experimental group of non-design students as Group N2. The experimental design of the research is shown below in Table 1.

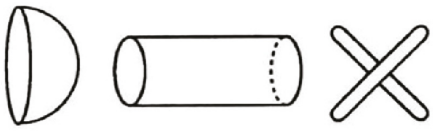


Figure 3. *Geometric objects that were given to the participants: a half sphere, a cylinder and an X-shaped object.*

4.4. Data analysis

AUT creativity measures analysis

The results of AUT were measured across three sub-categories: fluency, flexibility and originality scores, the totals of which were calculated. Fluency score is the total number of responses

Table 1. *The experimental design of the research.*

Design Students (26 Participants)		**Non-design students (26 Participants)**	
Control Group (Group D1) (13 Participants)	Experimental Group (Group D2) (13 Participants)	Control Group (Group N1) (13 Participants)	Experimental Group (Group N2) (13 Participants)
They are given an object category at the beginning of the experiment.	They are given the object category after combining the parts.	They are given an object category at the beginning of the experiment.	They are given the object category after combining the parts.

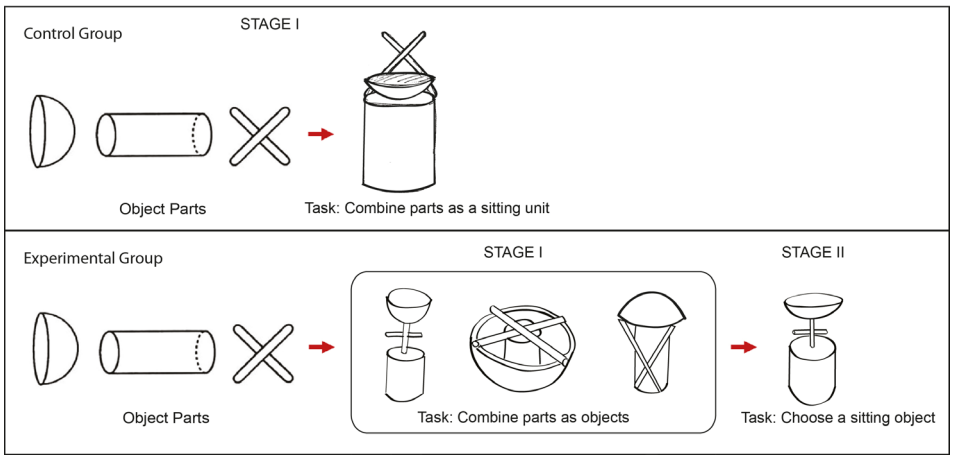


Figure 4. *Participants' experimental task sketches of Stage I and Stage II.*

to a stimulant given; flexibility score is determined by the number of conceptual categories the given responses fall into; and originality score is determined by statistical infrequency of generated uses. The total fluency, flexibility and originality scores and total AUT scores of the test were used in the statistical work.

According to the results of the AUT, there was no statistically significant difference between the total fluency, flexibility and originality and total AUT scores of the groups as demonstrated by one-way ANOVA, meaning that students were divided into equal groups on the basis of their creativity scores (For Fluency: $F(3,48)= 0.565$, $p = 0.641$ ($p > 0.05$); for flexibility: $F(3,48) = 0.567$, $p = 0.639$ ($p > 0.05$); for originality: $F(3,48) = 0.145$; $p = 0.932$ ($p > 0.05$) and the total scores of these categories (AUT total score) is $F(3,48) = 0.514$, $p = 0.675$ ($p > 0.05$)).

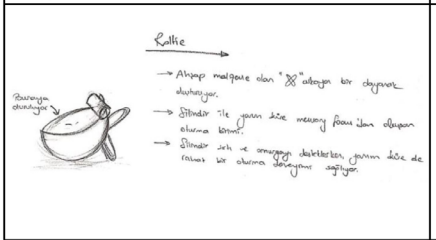
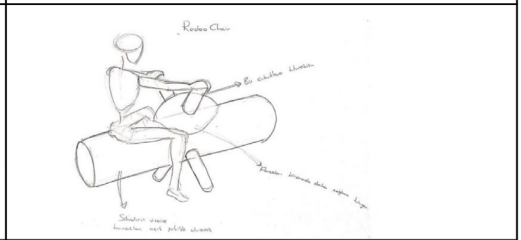
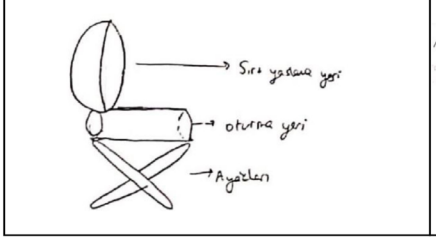
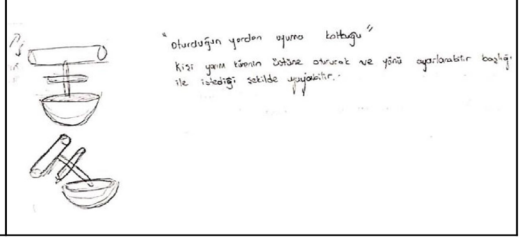
Creativity task data analysis

All "sitting unit" forms created by the four experiment groups were rated by three independent judges. The judges were academicians in industrial design. The evaluation criteria were based on the definition of creativity, the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful) (Amabile, 1983; Sternberg & Lubart, 1999; Runco & Jaeger, 2012). Also, according to Finke (1990), "creative" discoveries are defined according to these two separate dimensions: the usefulness (or practicality) and the originality of an object. Thus the "sitting units" were evaluated in terms of usefulness (or practicality), defined as an object involving an actual use in a context, and originality, defined as being novel, unique and infrequent. To measure the degree of originality and usefulness, the 5-point Likert scale was used. Objects created by the participants were evaluated by an expert jury, on a scale ranging from 1 (not original) to 5 (very original) and 1 (not useful) to 5 (very useful). The composite scores were calculated from the ratings of each items. The reliability and correlation analyses were completed to understand whether there was an agreement or not. The "sitting unit" forms that were created by control and experimental groups are shown in Table 2.

5. Results and discussion

The reliability and correlation tests revealed that there was a significant agreement and positive correlation between the jury's ratings for usefulness and originality. Since the distribution of data is not normal, the level of agreement between judges is defined by calculating the mean of Spearman's rho correlations and Cronbach's alpha. The usefulness ratings of jury-1 positively correlated with jury-2 ($r = 0.726$, $p < 0.05$); jury-2 positively correlated with jury-3 ($r = 0.759$, $p <$

Table 2. *Sample sketches of the control and experimental groups of design students and non-design students.*

An example of a "sitting unit" by the control group of design students	An example of a "sitting unit" by the experimental group of design students
	
An example of a "sitting unit" by the control group of non-design students	**An example of a "sitting unit" by the experimental group of non-design students**
	

0.05); and jury-1 positively correlated with jury-3 ($r = 0.725$, $p < 0.05$). The originality ratings of jury-1 positively correlated with jury-2 ($r = 0.791$, $p < 0.05$); jury-2 positively correlated with jury-3 ($r = 0.778$, $p < 0.05$); and jury-1 positively correlated with jury-3 ($r = 0.771$, $p < 0.05$).

The interclass Cronbach's alpha (inter-rater reliability) of ratings for usefulness was 0.926 and for originality 0.908. This indicates a high level of internal consistency for the scale of this sample.

The Kruskal-Wallis H test showed that there was a significant difference for the usefulness ($\chi2(3) = 31.944$, $p < 0.001$), originality ($\chi2(3) = 35.011$, $p < 0.001$) and creativity (total usefulness and originality ratings) ($\chi2(3) = 38.132$, $p < 0.001$) between groups.

The experimental groups of design and non-design students (who designed sitting units without knowing the object category) got higher creativity scores compared to the matching control groups who designed the sitting units with a given object category.

The result of the comparison of the experimental group and control group of design students and non-design students were as follows: for "usefulness" ratings; Group D2 (N = 13, Mean Rank = 17.85) and Group D1 (N = 13, Mean Rank = 9.15) (U = 28.000, $p < 0.01$); Group N2 (N = 13, Mean Rank = 19.35) and Group N1 (N = 13, Mean Rank = 7.65) (U = 8.500, $p < 0.001$); for originality ratings; Group D2 (N= 13, Mean Rank = 19.12) and Group D1 (N= 13, Mean Rank = 7.88) (U= 11.500, $p < 0.001$); Group N2 (N = 13, Mean Rank = 19.46) and Group N1 (N = 13, Mean Rank = 7.54) (U= 7.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D2 (N= 13, Mean Rank = 19.38) and Group D1 (N= 13, Mean Rank = 7.62) (U= 8.000, $p < 0.001$); Group N2 (N = 13, Mean Rank = 19.81) and Group N1 (N = 13, Mean Rank = 7.19) (U = 2.500, $p < 0.001$). The experimental group of design students got higher scores on all criteria.

Also, the comparison of experimental groups of design students with experimental and control groups of non-design students were as follows: for "usefulness" ratings; Group D2 (N = 13, Mean Rank = 18.12) and Group N2 (N=13, Mean Rank = 8.88) (U = 24.500, $p < 0.01$); Group D2 (N =13, Mean Rank = 19.92) and Group N1 (N = 13, Mean Rank = 7.08) (U = 1000, $p < 0.001$); for originality ratings; Group D2 (N = 13, Mean Rank = 16.85) and Group N2 (N = 13, Mean Rank = 10.15) (U= 41.000, $p < 0.05$); Group D2 (N = 13, Mean Rank = 20.00) and Group N1 (N = 13, Mean Rank = 7.00) (U = 0.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D2 (N = 13, Mean Rank = 18.38) and Group N2 (N = 13, Mean Rank = 8.62) (U= 21.000, $p < 0.01$); Group D2 (N = 13, Mean Rank = 20.00) and Group N1 (N = 13, Mean Rank = 7.00) (U = 0.000, $p < 0.001$).

These results supported the previous "Mental Synthesis Task" results of Finke (1990) and revealed that when the participants are informed of the task after creating forms, they get higher "usefulness" and "originality" ratings. Both of the experimental groups showed better performances on pretense/seeing *as if* or seeing-possible-affordances ability than the control group of non-design

Table 3. *The significant differences of groups according to the result of the Mann-Whitney U Test.*

	Usefulness		Originality		Creativity	
	Asymp. Sig. (2-tailed)		Asymp. Sig. (2-tailed)		Asymp. Sig. (2-tailed)	
Experimental Group / Control Group	**D2**	**N2**	**D2**	**N2**	**D2**	**N2**
D1	$p < 0.01$	$p > 0.05$	$p < 0.001$	$p > 0.05$	$p < 0.001$	$p > 0.05$
N1	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

students. To review the findings according to affordance, pretense and design association, experimental groups created free forms and afterwards tried to see those forms as if (pretend) they are sitting units; they found the sitting affordances of those objects which resulted higher creativity scores.

The control groups received lower creativity scores. Having been given the "sitting unit" brief in the first part of the experiment, they imagined more limited forms and created "sitting unit forms" with less creativity than experimental groups of their peers (See Figure 5).

When we look at the comparisons between control groups, the non-design control group showed the lowest creativity performance with the forms they created. The comparison of control groups of design and non-design students were as follows: for "usefulness" ratings; Group D1 (N = 13, Mean Rank = 18.88) and Group N1 (N = 13, Mean Rank = 8.12) (U= 14.500, $p < 0.001$); for "originality" ratings; Group D1 (N = 13, Mean Rank = 19.23) and Group N1 (N = 13, Mean Rank = 7.77) (U= 10.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D1 (N = 13, Mean Rank = 19.35) and Group N1 (N = 13, Mean Rank = 7.65) (U= 8.500, $p < 0.001$).

Both design and non-design control group participants started the form-giving process focusing on the "sitting function" of the combined parts considering the sitting affordances of the object in a flexible manner. This resulted in lower creative performance.

There is no statistically significant difference between the designer control group and the non-designer experimental group according to creativity scores (total ratings of usefulness and originality); (Group D1 (N= 13, Mean rank = 11.08) and Group N2 (N= 13, Mean rank = 15.92) (U= 53.000, $p > 0.05$). This result revealed that both the control group of design students and the experimental group of non-design students showed closer performances on creativity related with pretense

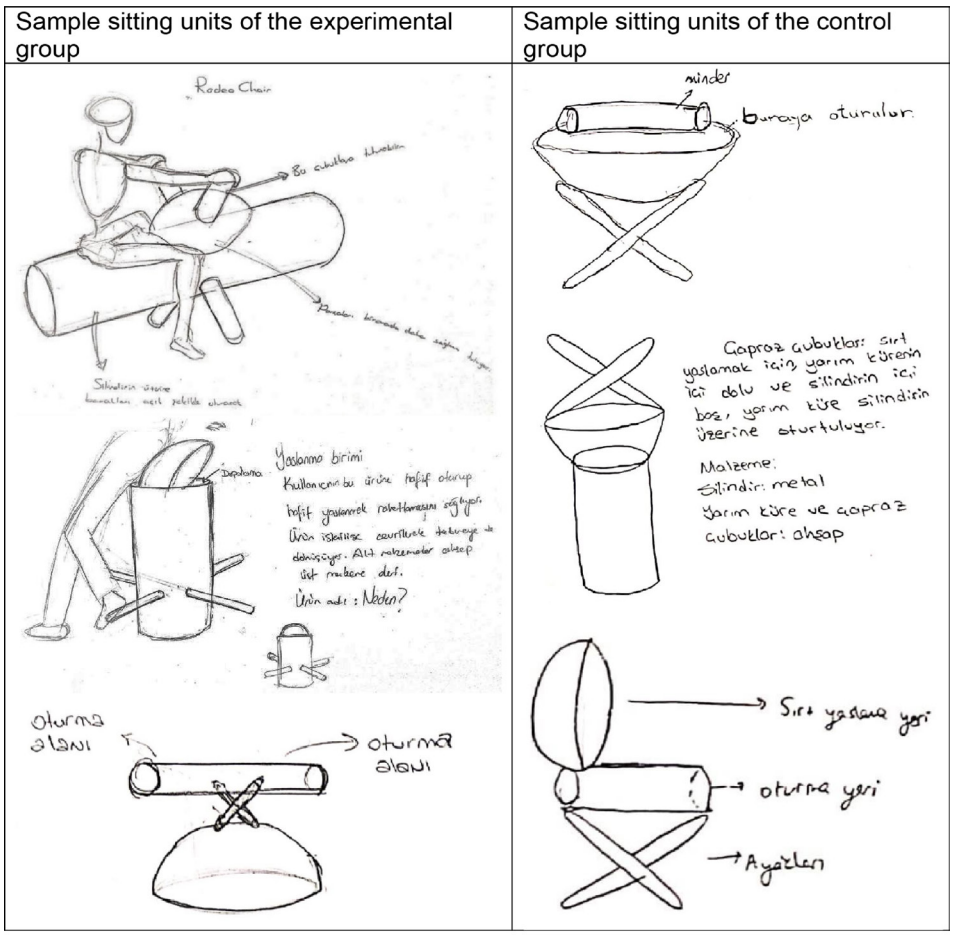


Figure 5. *A sample of sitting units designed by the experimental and control groups.*

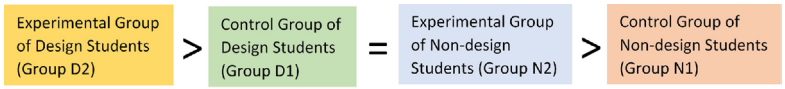


Figure 6. *A simple schema of the overall total creativity scores of groups.*

ability which is based on seeing possible affordances (sitting) in their forms.

The overall total creativity scores of the 4 groups are illustrated in Figure 6.

As a result, as shown in Figure 6, the experimental group of design students exhibited the highest level of creativity on the creative mental synthesis task compared to the other groups. This result supports the description of the relationship between "pretense" (acting *as if*) and early design phase as we hypothesized. Pretend play, which is normally assumed to be peculiar to childhood, is a part of design education in adulthood. Design education supports students by enabling them to think flexibly and develop skills in this direction. For this reason, in the experiment where the pretense process was simulated, the experimental group of design students exhibited the highest levels of creativity in pretense (acting *as if*) among the four groups. Designers always try to create possible world scenarios by thinking about the possible solutions suitable for the design problems they face with the "what if"/ "as if" perspective in order to achieve flexible thinking capacity like children. In other words, in the process of creating forms in the early design phase, they can produce creative solutions in a flexible way by seeing "affordances of objects", or "new possibilities of action". While designing new objects, designers take the role of "pretenders" and think/imagine action possibilities just as children, in their pretend play, assign affordance relationships to objects.

6. Conclusion

This paper proposes that there is a high degree of similarity between the "affordance-based pretense framework of design creativity" in the pretend play of children and the creative design process associated with the concept of affordance. Then experimental tasks – an alternate uses test (AUT) and a creative mental synthesis task – which are based on "affordance-based pretense framework of design creativity" were conducted to compare the result of the mental synthesis task results of design students and non-design students to pretense ability. This would verify the differences of pretending or seeing *as if* ability in mental synthesis task related to creative performances.

The findings of this research demonstrate that participants showed better performances when they spontaneously combine the parts and create free forms and then search for "sitting" affordances among these forms. This process could be interpreted as *searching for* and *discovery of affordances*. The result of the mental synthesis task" can be interpreted to be associated with the *seeing-as-if* or *seeing-affordances-in* ability (Rucińska, 2015) of subjects. The results support that the experimental group of design students, like children, try to discover new action possibilities and see affordances in objects in the context of use. They performed better in seeing "sitting" affordance in their object forms. Additionally, this study supports the idea that it is possible to increase the flexibility of the "seeing affordances in" ability, with which people perform mental figural synthesis and discover possibilities. This process is related to creativity because creativity often involves the ability to go beyond the immediate meanings and find hidden properties and possibilities.

The affordance or action possibilities-searching process could be seen both in the pretend play of children and in the experimental group in the mental synthesis task as shown in Figure 7. The child looks around for the affordance match of a phone in her play. Then she finds the banana and uses it as a phone in her play. It can be said that children can treat one thing as another because they see the action possibilities - in other words, affordances - in objects while playing in new contexts (Rucińska, 2015). In different pretend play contexts, a child can play with various kinds of objects by seeing the action potentials in them. Seeing the affordance potentials of objects' relation to the agent enables pretense behavior.

Likewise, the experimental groups in the mental synthesis task create some object forms spontaneously in the first

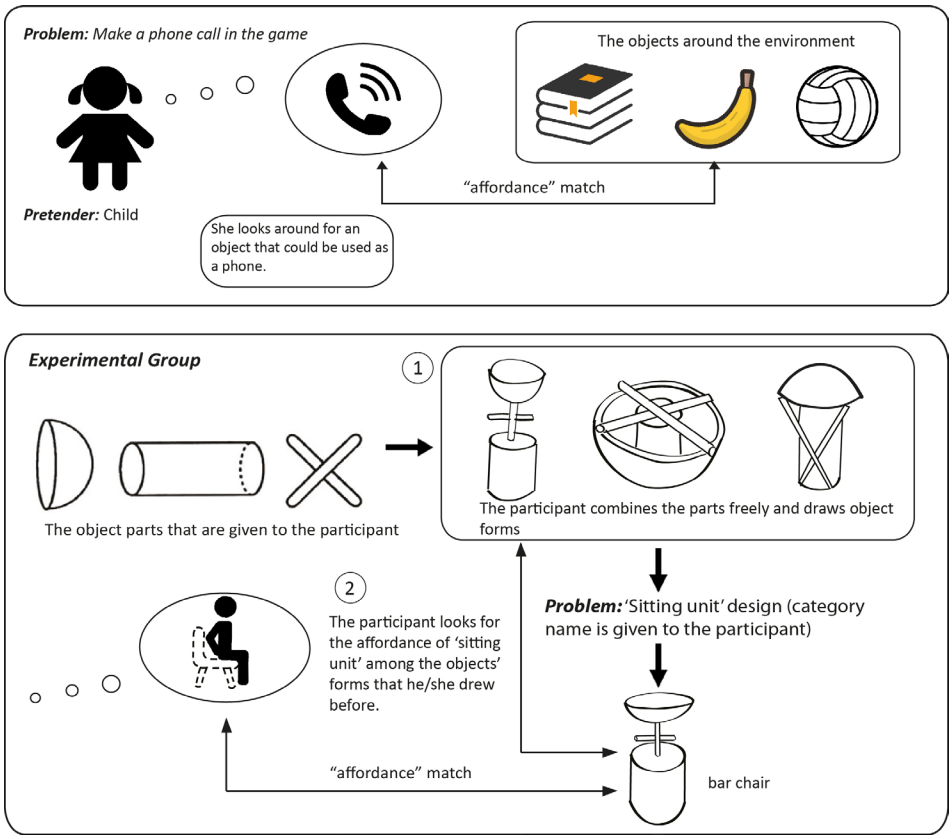


Figure 7. *The similarities between the pretend play of children and the procedure of experimental group in a creative mental synthesis task.*

part of the task. Then they are given the object category name: "sitting unit." Subsequently, they look for the affordances for "sitting" in their object forms which they drew previously. This process is related with creativity as the person imagines and combines object forms in new ways and sees new action possibilities.

In conclusion, Vygotsky (2004, p.10) claimed that "creativity is present, in actuality, not only when great historical works are born but also whenever a person imagines, combines, alters, and creates something new." Transforming the way of thinking, overcoming limitations and imagining possible solutions are complicated processes. Sometimes people are unable to see new ways of using objects (Purcell and Gero, 1996). Pretense encourages people to see new interaction possibilities in objects. While children can automatically pretend (Carruthers, 2002; Mitchell, 2002; Weisberg & Gopnik, 2013; Rucińska, 2015) and "see things as other things" in different contexts, designers learn this process while designing and try to see beyond the conventional uses of objects and imagine other possibilities. Pretense enables people to exercise the seeing *as if* ability for suppressing habitual or obvious responses and selecting more unusual possibilities. This is called bypassing the obvious and selecting the non-obvious (Picciuto & Carruthers, 2014). For example, when we see a chair, we first think it is for "sitting" because we usually use a chair for sitting even though we may use it in many other ways. Thus, "the concept of affordance challenges designers to avoid the reliance on symbols and cultural conventions in design" (You & Chen, 2007, p. 29).

In the design process, designers should pay attention to the possible meaningful interactions between products and users. Related with creativity, flexible thinking is essential for responding to unexpectedness in the design process. Therefore, taking an affordance-based view of pretense could allow designers to imagine and think about the possible user–product interactions and create the possible solutions to design problems and satisfy the varied needs of users. Furthermore,

pretense could be an effective practice to inhibit a pre-defined way of use and may lead to the discovery of new ideas in the design process. There are many possibilities for action that objects and may afford in terms of design. It's important to encourage designers to imagine and see these possibilities in different contexts of use to satisfy the varied needs of users.

As basic research, the current could make a significant contribution towards understanding pretense from a cognitive perspective, too. It is claimed that designers perform *as if*, act, and seek affordances as adults, similarly to early childhood pretend play. The results of this study, therefore, contrast with the traditional assumption that pretend play is only seen in childhood. Accordingly, this view merits consideration in further studies.

The results of this study seem to be valuable both from the perspective of design research and from the perspective of cognitive science in general. First, the relationship of design creativity and pretense was described in the framework of seeing-as if ability related with affordances. Second, as having a place in creative cognition literature the creative mental synthesis task was repeated from a new viewpoint and interpreted with the relationship of pretense ability and design creativity. The present study provides encouraging results for the research of the relationship between early design process and the pretense process of children.

Although the research has reached useful results to describe the affordance-based pretense framework of design creativity, there were some unavoidable limitations. First, the research was conducted only with small size of population (N=52) of university students. Therefore, to generalize the results for larger groups, the study should involve more participants at different design expertise levels and professions in future research. Second, and far more important, creative processes of human mind in cognitive studies are still being explored from multiple perspectives. This study should also be expanded considering relative processes such as analogy making, visual imagery, emotional intelligence etc., in design.

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