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The play pyramid: a play classification and ideation tool for toy design

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Abstract: Toy designers and students may benefit from a universal classification system to communicate and ideate new toy concepts. In this paper, we present two graphical tools that help designers to classify and manipulate toy product concepts. The play pyramid is a three-dimensional map that allows designers to classify a toy concept by placing it in a space between what we believe to be four independent axes of play (sensory, fantasy, construction and challenge). The sliding scales of play are modifiers or adjectives that one can use to further describe the play of a toy concept. By taking a toy design and moving it around inside the play pyramid or along the scales of play, the design can take on new and unforeseen play affordances. Both of these tools have been tested and applied in industry sponsored research and design education settings and were successful in expanding upon toy ideas.

Keywords: affordances; arts and technology; classification; idea generation; toys; toy design; toy design education; play; play pyramid; play value.

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Biographical notes: Barry M. Kudrowitz received his Masters of Mechanical Engineering from MIT in 2006 studying Nerf® and Super Soaker® design. Currently, he is pursuing his PhD in the Department of MIT Mechanical Engineering studying relationships between humour, creativity and innovation under the advisement of Professor David Wallace. He is the course instructor and cocreator of 2.00b Toy Product Design, an introductory course in product design process for students at the Massachusetts Institute of Technology. He is also one of the founders of the MIT Toy Lab. His work has appeared on television shows including: The Martha Stewart Show®, Design Squad and Mythbusters®.

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1 Introduction

Classification is the first step in bringing order into a scientific endeavour (Ashby and Johnson, 2002). Just as wine connoisseurs use a wine wheel to communicate the complexity of wine flavour and perfumers use a fragrance wheel, toy designers might benefit from a simple universal classification system to communicate and improve upon toy concepts. A classification system might also be helpful in determining if a toy product has potential play value.

In this paper, we present two graphical tools that help designers classify and manipulate toy product concepts. The play pyramid is a three-dimensional map that allows designers to classify a toy concept by placing it in a space between what we believe to be four independent and comprehensive classes of play (sensory, fantasy, construction, challenge). The sliding scales of play are modifiers or adjectives that one can use to further describe the play of a toy concept.

Before we delve into play classification, we would first like to define several keywords and phrases.

2 Brainstorming, toy products, play, affordances and play value

2.1 Brainstorming

There are many methods that designers use to come up with new ideas for products and creative solutions to problems. These idea generation (or *ideation*) methods can be grouped into two categories: free form idea generation (brainstorming, free association, brainwriting, etc.); and structured idea generation (TRIZ, morphological analysis, SCAMPER, etc.) (Michalko, 2006; Ulrich and Eppinger, 2004). The free form methods tend to favour blue-sky design and initial stages of design (typically performed as a group) while the structured methods are perhaps more suitable for detailed design stages (typically performed by individuals). Our toy design pedagogy and research practices use mostly free form ideation methods and, in particular, the process known as brainstorming. The formal concept of brainstorming was developed by Alex Osborn in the 1930s and written about in his book, *Applied Imagination* (1963). Essentially, in a brainstorming session, a group of people sit together to generate a large number of ideas in a short amount of time. The participants quickly sketch any idea that comes to mind and present it to the group. The rules of a good brainstorm session are to defer judgment and not critique ideas, build off of each other's ideas, encourage wild ideas and challenge assumptions. In our work, we are typically brainstorming new toy concepts or brainstorming ways of manipulating toy concepts.

2.2 Toy products

A *toy* is a tangible item that is used for play. Anything can serve as a toy (pen caps, rubber bands, a cardboard box, etc.); however, as professionals in the toy design industry, we are primarily concerned with *toy products*, which we will define as tangible items that are designed to function primarily for play with the intention of being manufactured.

2.3 Play: fun, free movement with given affordances

Defining play tends to be challenging – it is an abstract concept and there are several definitions that focus on different elements. We will draw upon several sources to present what we feel is an appropriate definition of play for toy designers. Mark Twain comments that play and work are words used to describe the same activity under different circumstances (Thomas, 1905). We will say that *play* is a quality of mind (not a specific activity) that falls on a scale with the opposite end being work. We must clarify when using the homophone ‘work’ as we (and perhaps Mr. Twain) do not mean ‘career’ or ‘effort’, but rather ‘undesirable chore’. It is not uncommon for play to emerge in the work place and/or require effort on the part of the player. Additionally, seriousness is not the opposite of play, as some may propose. It is very possible for seriousness and playfulness to go hand-in-hand in activities (e.g. card games).

We would like to further refine our definition by incorporating elements from works of the Dutch anthropologist Johann Huizinga and the French sociologist Roger Caillois. In *Homo Ludens*, Huizinga asserts that play must meet the following criteria: it has a fun element, it is outside ordinary life, it is voluntary, it is utterly absorbing, it is not associated with material interest or profit, it takes place in its own boundaries of time and space, it proceeds according to rules and it creates social groups that separate themselves from the outside world (1950). In *Man, Play and Games*, Caillois asserts that play is: not obligatory (free), within circumscribed limits of space and time (separate), uncertain in outcomes, unproductive, governed by rules and make-believe (1962).

Table 1 provides a tabular comparison of these two definitions of play while presenting a list of attributes that take into account the overlapping themes. For the purposes of this paper, we believe that we can describe play effectively using the first four categories listed in Table 1:

Play is the quality of mind during enjoyable, captivating, intrinsically motivated and process focused activities.

By using the word ‘captivating’, we are evoking the concept of flow, where the player is fully engaged or absorbed in the activity (Csikszentmihalyi, 1991). The term ‘intrinsically motivated’ refers to what Caillois calls ‘Free’ where the activity is not obligatory and not a chore. The term ‘process-focused’ is used to differentiate from product-focused activities. In process-focused activities, the player is engaged because of the activity itself and not for the outcome. We would argue that play does not require an element of pretense. Some people find vacuuming the house, building a table, counting change or (to evoke Twain) whitewashing a fence to be play and these activities are very much based in the ordinary world and are not considered make-believe activities. The latter four characteristics on the list (based on rules, space and time bounded, forms social groups and has uncertain outcomes) are more specific to play in the form of games.

The definition taken from the attributes of Table 1 is acceptable for understanding play, but is rather long and at a meta-level. It is similar to defining a toaster as: a

consumer product that is space efficient, easy to use, contains heating elements and allows for insertion of food products such as bread. A more functional and aesthetically pleasing definition of a toaster would be: a product that browns bread with radiant heat. Salen and Zimmerman define play for game design as ‘free movement within a more rigid structure (2004, p.304)’, which is at first glance simply the mechanical definition of play as in the play between gears. If one looks deeper into this definition, the ‘rigid structures’ can be viewed as product affordances and the ‘free movement’ is the captivating, intrinsically motivated, and process-focused activity. Thus, we propose a more functional and aesthetically pleasing definition of *play for toy design*:

Play is fun, free movement with given affordances (oppositely, work, as in a chore, does not allow for free movement with the given affordances).

Table 1 Comparison of attributes of play

| <i>Play attribute</i> | <i>Huizinga (1950)</i> | <i>Caillois (1962)</i> |
|-------------------------|---------------------------|------------------------|
| Enjoyable | Fun element | – |
| Captivating | Utterly absorbing | – |
| Intrinsically motivated | Voluntary | Free |
| Process-focused | No profit | Unproductive |
| Element of pretense | Outside ordinary life | Make-believe |
| Based on rules | Rule based | Governed by rules |
| Space/time bounded | Boundaries of time, space | Separate |
| Social groups | Creates social groups | – |
| Uncertain outcomes | – | Uncertain |

2.4 *Affordances*

An *affordance*, as defined by Norman (1988), is an action potential of an object, which is something that limits and guides what you can do with an object. There are an infinite number of affordances for any given product and, so to indicate a product’s intended use, designers emphasise certain affordances (e.g. if the product should be held in a certain location, it should be made obvious where the hand should be placed). For a toy, we will use the term *play affordance* to describe a way in which the user is intended to play with the toy.

2.5 *Play value*

When referring to toys, the term *play value* could be the likeliness that a toy will be played with by the user. Play value could also be used to describe a measure of the benefit of the play. Play value could also refer to the amount, variety or length of play. For the purpose of this paper, we will say that a toy has play value if it affords play (i.e. it affords activities that are enjoyable, captivating, intrinsically motivated and process focused).

While a designer may believe that their toy concept has play value, the user is the one that ultimately makes this decision. A toy is in the mind of the user, but a *toy product* is in the mind of a designer. Ideally, the toy product is similar in the mind of the user and the designer. This is not to say that toy products should only be used in the intended

manner, but rather, the designer should have a sense of what the user desires so to create appropriate play affordances.

Brian Sutton-Smith writes “it is dangerous to pretend we know what a child will do with a toy just from its characteristics alone; children have a way of doing things with toys over and beyond the apparent character of the toy (1986, p.38)”. It is true that children (and adults) can find play value in things that are not toy products (what we call *transformed toys*) and children and adults will play with toys in ways that are not expected or intended. However, when designing a toy product, the designer should ensure that it affords at least one type of play, thus suggesting play value. A classification, such as the play pyramid, can be used to determine if a toy product affords play.

3 The play pyramid

In defining a concise and simple classification of play, we began by grouping toys and activities that are typically considered play. After sorting through hundreds of toy products, four general categories began to emerge. We defined these four general categories of play as: sensory, fantasy, construction and challenge.

We would like to further explain each category and what types of play or toys would fall into each.

3.1 Sensory

This category of play involves aesthetics and entertaining the senses. All play can be thought of as sensory as we perceive things, but sensory play involves specified and intentional entertaining of the senses. Play and toys that would be considered a pure form of this play would include: a kaleidoscope, a music box, a toy maraca, a squishy or stretchy ball, most tactile play, digging in sand, splashing water, a jack-in-the-box, a Whoopee Cushion® and water slides. What puts these examples in the sensory play category is that the enjoyable, captivating, intrinsically motivated and process focused elements come from how the toy or play feels, smells, tastes, sounds or looks.

3.2 Fantasy

This category of play is about role-playing, make believe or it has a level of pretense. This category is, what is typically, associated with play, but we believe it is possible to have play without this fantasy element. Examples of pure forms of fantasy toys and play would include: playing house or doctor, action figures, dolls and doll houses, puppets, some video games, toy tea sets, toy guns and toy cars. What puts these examples in the fantasy play category is that the enjoyable, captivating, intrinsically motivated and process focused elements come from how the toy or play puts the player into a world or state of mind that is outside of the ordinary.

3.3 *Construction*

This category of play is about creating and making things (and not simply construction sets). It is not as general as creative thought as all play involves some level of creativity. The construction category is similar to and slightly broader than what Huizinga (1950) terms the ‘Musical and Plastic Arts’ and includes, but is not limited to, intentional creation in the areas of art, design, music, science and language. It also includes the construction of a set in the form of creating a collection. Examples of pure forms of construction toys and play would include: making up new words, chipping away at a stone, un-themed building blocks and construction sets, doodling and beading a necklace. What puts these examples in the construction play category is that the enjoyable, captivating, intrinsically motivated and process focused elements come from how the toy or play allows the user to create.

3.4 *Challenge*

This category of play is about testing one’s abilities against other entities or against oneself. This category maps to what Huizinga (1950) calls ‘Contest’ or ‘Competition’. Like all play types, this can be physical or mental. Physical challenges include both fine and gross motor skill development. Mental challenges would include riddles and puzzles, but also many educational toys. Examples of relatively pure forms of challenge toys and play would include: most games, puzzles, riddles, Frisbee®, catch, word search, cards and juggling. What puts these examples in the challenge play category is that the enjoyable, captivating, intrinsically motivated and process focused elements come from how the toy or play challenges the player.

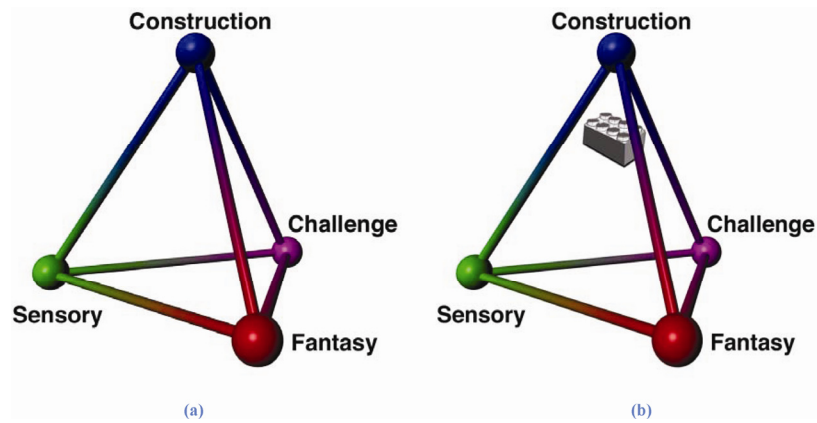
3.5 *Summary*

We believe these categories can be applied to any toy or play, do not depend on age, and can be distinguished from each other. We propose that all toys or play can be classified into one of four categories or a combination of two or more of these four categories. When using this classification, it is important to classify play based on where the play value lies. Often times a toy affords more than one type of play.

We are not claiming that this is the ‘best’ play classification. Rather, it is a simple classification suited for toy product design and toy design education. In developing this classification into a tool, we view these four categories as the vertices of a tetrahedron. By having a classification with only a few independent categories, it allows one to plot a toy concept onto a three-dimensional space that can be readily visualised using a tetrahedron. It is difficult to visualise a classification space for systems that contain more than four axes.

Each edge of the tetrahedron maps to play that falls between two categories. The faces consist of play that falls between three categories. The volume inside the tetrahedron is for play that has elements of all four categories of play. This classification system, as shown in Figure 1(a), is what we call the play pyramid.

Figure 1 The play pyramid classification (a) and the play pyramid with a suggested placement of Lego® (b) (see online version for colours)



4 Prior work and the sliding scales of play

There are few published play classifications. From a toy design viewpoint, some play classifications seem to categorise play into groups that cannot be clearly distinguished from one another (e.g. imaginative vs. storytelling, active vs. manipulative). Other classifications are too specific and lengthy to be used as an effective tool for design (e.g. outdoor playground play, small object manipulation). Still others categorise by developmental stage or cultural impact, which is helpful for specific purposes, but not general design. However, prior play classifications were a useful foundation for developing the categories used in the play pyramid.

Piaget's stages of cognitive development describe play and activities that are associated with children as they develop. Piaget's stages are summarised as follows (Bee and Boyd, 2000):

Sensory-motor period (0–18 months) – the child engages in sensory play and play that involves moving objects to produce reactions.

Preoperational stage (18 months–6 years) – The child engages in symbolic play. Rules are not developed (4–7 years) – the child can perceive and imagine.

Period of concrete operations (6–12) – the child engages in more problem solving play. Play involves classification and rules.

Period of formal operations (12–15) – thought and play become more abstract. Play becomes more social and refined.

Piaget's sensory-motor stage maps to what we call sensory play and his preoperational stage maps to what we call fantasy play, but it is less clear how his later two stages map to our classification. Piaget's stages might be helpful in determining if a toy would be acceptable for a given age range; however, in the current format, they are not suitable for classifying toys. For example, there are toys that would be classified as a sensory play toy, but could be more appropriate for adults rather than children under 18 months of age.

Huizinga categorises play in *Home Ludens* (1950) by the manners in which it appears in culture including: Language, Contest, Law, War, Poetry, Art, Philosophy, etc. This is quite hard to relate to toy design, but two of his categories map nicely to the play pyramid. Our challenge category maps to what Huizinga calls ‘contest’ or ‘competition’ and our construction category maps to what Huizinga terms the ‘Musical and Plastic Arts’. Huizinga also states that the higher forms of play can be derived from the two basic aspects ‘a contest for something’ and ‘a representation of something (1950)’. The former is again what we term challenge and the latter describes our fantasy category of play. Huizinga does not address sensory play and it is rarely addressed by any other classification. Some classifications use the term ‘manipulative’ play or ‘exploration’, but these are only elements of what we call sensory.

Exploration (for babies) is addressed by Sutton-Smith as *not* being play. Sutton Smith defines exploration as “cautiously and gradually exposing the receptors to portions of the environment [where] the goals or incentives consist of sensory stimulation and novel stimuli in any modality” using a quote by Dr. Roberta Collard (1986, p.143). Exploration, as defined in Sutton Smith’s work, is similar to what we call sensory play. Sutton-Smith claims that this is actually work and not play when dealing with babies as they are trying to understand the world around them. It is hard for us to say if a baby views this as work or play, however, when this type of activity is enjoyed by older children and adults we would refer to it as play (e.g. stomping in snow, stretching gum, popping bubbles, masturbating). For now, we will not claim to know if sensory activities performed by babies are play or work or something else, instead we will say that there are a significant number of toys and play that are purely based on entertaining the senses for children and adults thus warranting a place in our classification.

There are a few additional schemes for classifying types of play, as shown in Table 2.

Roger Caillois developed a classification, which includes Agon (competition), Alea (chance), Mimicry (pretend), and Ilinx (perception disruption, vertigo) (1962). This classification is simple, but specific to games. In contrast, Del Vecchio (2003) has a classification that is specific to toy products but is too detailed and interrelated to develop into an elegant graphical tool.

Table 2 Prior classifications of play

| <i>The National Institute for Play (2006)</i> | <i>Gene Del Vecchio (The Blockbuster Toy, 2003)</i> | <i>Goodson and Bronson (The Consumer Product Safety Commission, 1997)</i> | <i>Roger Caillois (Man et al., 1962)</i> |
|---|---|---|--|
| Body play | Mastery play | Active play | Agon (competition) |
| Object play | Creation play | Manipulative play | Alea (chance) |
| Social play | Nurturing play | Make-believe play | Mimicry (pretend) |
| Imaginative/pretend play | Emulation play | Creative play | Ilinx (perception disruption) |
| Storytelling play | Friend play | Learning play | |
| Creative play | Collection play | | |
| Attunement play | Storytelling play | | |
| | Experience Play | | |

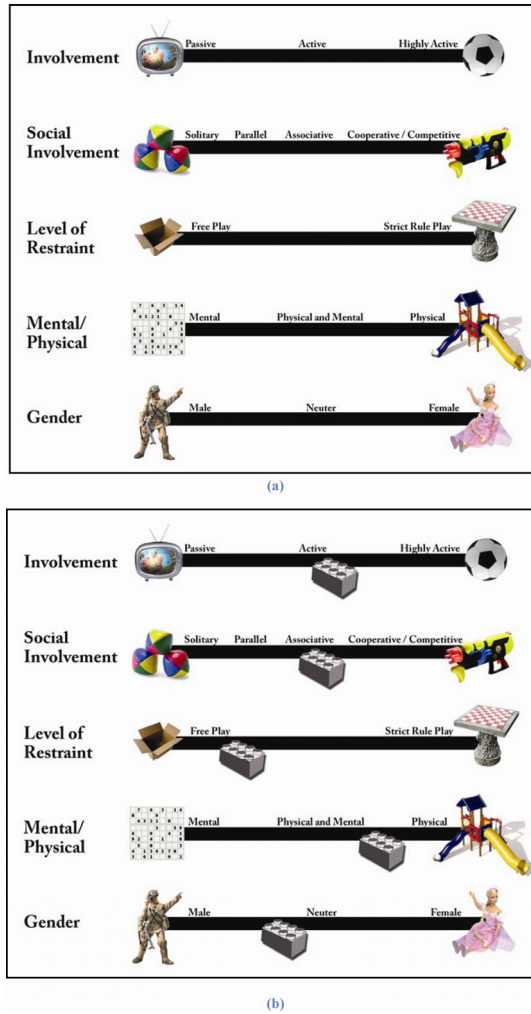
In the National Institute for Play (2006) and the Consumer Product Safety Commission (Goodson & Bronson, 1997) classifications, categories such as ‘object play’ or ‘manipulative play’ are of little use to a toy designer as all toy products can fall into such categories. These classifications also contain modifiers such as ‘social play’ or ‘active play’. Modifiers like ‘social’ and ‘active’ are not explicitly types of play, but adjectives that describe different play types. To clarify, it would be hard to engage in ‘social’ or ‘active’ play without it being of some other nature (i.e. is one actively constructing? Is one actively competing?). These modifiers are still useful, although not as primary classifications. Modifiers can be used to describe each type of play independent of classification. Caillois addresses modifiers in his work, but has only one, which is based on the level of restraint of the play. He calls his modifier *Paida/Ludus* meaning free-form play or rule-bound play (Caillois, 1962). In Caillois’ classification, *Agon* (competition) play, for example, can either be *Paida* (free-form) or *Ludus* (rule-based). Unlike Caillois, our modifiers are viewed as *scales* where a type of play can float anywhere between two extremes such as *Paida* and *Ludus*. We present five applicable modifier scales to describe toys and play: involvement, social involvement, level of restraint, mental/physical and gender.

Involvement refers to the amount of effort the participant is exerting and it ranges from passive (e.g. watching football on TV) to highly active (e.g. playing a game of football). Social involvement refers to the level of interaction with other players and ranges from solitary (e.g. *solitaire*) to cooperative/competitive (e.g. *Poker*) based on the six classifications of social pre-school play (Parten, 1933). Level of restraint refers to the amount of rules and ranges from free play (e.g. splashing in water) to strict rule play (e.g. water polo). The mental to physical scale has a midpoint of equal amounts of mental and physical play. The gender scale ranges from male to neuter to female. These five scales, as shown in Figure 2(a), are what the authors call the sliding scales of play.

The sliding scales of play can be used as an ideation tool. Just as a designer can plot a toy into the play pyramid, a designer can plot a toy concept onto the scales and then, by sliding the scales of play, the designer can imagine other possibilities for their toy. As an example, let us look at a standard set of *Lego*® construction blocks and plot them on the scales of play as shown in Figure 2(b). *Lego*® could be characterised as active, but not highly active, typically not competitive, closer to free play than strict rule play, a bit more physical than mental, and neuter leaning towards male. How can one redesign the toy to make it more active? Perhaps if each toy block were a meter wide, the play would require more movement. How can one redesign the toy to make it even more free play? Perhaps if the placement of the connecting pegs were not fixed, the play would allow for more build options. In these cases, the play gets modified, but the overall play classification remains unchanged (i.e. all of these redesigns would still be considered construction play).

The sliding scales of play are not classifications and cannot be used to determine if a toy has play value. For example, an object that is gender neutral, designed for solitary, active, physical use with few associated rules does not imply that it has play value. When one begins to reference the categories of the play pyramid (sensory, fantasy, construction, challenge), then play affordances emerge and play value becomes apparent.

Figure 2 The sliding scales of play (a) and an application showing a suggested placement of Lego® (b) (see online version for colours)



5 Using the play pyramid

Designers and students can use the play pyramid to determine if a toy has potential play value. A toy can be said to have play value, or afford play, if it falls somewhere in or on the play pyramid.

We can plot current toy products into the pyramid. As shown in Figure 1(b), the basic Lego® building blocks would be located inside the pyramid near the construction vertex. Depending on the specific Lego® product, the toy can migrate towards other vertices, but will always have some element of construction play. This process can be used to see where successful toys for certain age groups are located. We can also see where there are gaps. Blank spaces in the diagram are perhaps market opportunities. The play pyramid can be used to plot new ideas for toys to relate them to current toys of similar play value.

It can also be used as an ideation tool. By taking a toy idea and moving it around inside the space of the pyramid, an idea for a toy can take on new and unseen play value.

Any toy can be used for any of our four classifications of play (with some degree of creativity), but what we would first like to determine is the outstanding perceived play affordance as suggested by the designers. To determine where toys would be placed in the pyramid, we asked an MIT class of 54 students (29 female, 25 male) to review a set of 23 toys that were chosen randomly from an online toy store. The students were asked to determine which classes of the play pyramid, if any, the toy product was intended to possess. The students were told what the general classes meant, but were not given detailed definitions or example products. The students ranged in age from 17 to 25. Out of the population of students, 45 were undeclared undergraduate freshmen and the remainder was a mix of undergraduate upperclassmen from various departments.

If over 15% of the students felt that a toy afforded a type of play, we determined it to be significant and obvious. About 15% was chosen as the threshold as there appeared to be a larger gap around this approximate number of responses. 2/23 toys, a mobile and a Darth Vader® action figure, had only one significant play category. 11/23 toys had two significant play categories. 8/23 toys had three significant play categories. 2/23 toys, Lego® Mindstorm® (Lego, 2009) and Robosaur® (Nitrotek, 2005), had all four significant play categories. There were no toys without a significant and obvious pyramid classification. The data for each toy product can be seen in Table 3.

This is only a small sample of toys, but we can see that construction play was the only category that did not have an occurrence of a 98–100% agreement on the presence of the affordance. This could be a result of not presenting a toy that clearly afforded construction play or it could mean that this category is slightly harder to understand or identify than the other three. If this sample of toy products is a good representation of the market, we can say that most toys on the market are designed with two or three significant play pyramid categories in mind and only a few toys are designed with all or one significant play pyramid category in mind. This evaluation could also be performed as an observation of children playing with the toys to find actual play affordances instead of intended play affordances.

There are toys on the market that have clear play affordances in all four of our classes of play. These toys would be plotted somewhere near the centre of the play pyramid. A toy or a form of play at the very centre of the pyramid would afford equal amounts of play from all four classes. Guitar Hero®, a video game developed for PlayStation® 2, is perhaps a good example of a successful and award winning toy that could be placed near the centre of the pyramid. This is a game in which the player uses a Mini Gibson® SG Guitar controller (*Fantasy*) to create (*Construction*) music (*Sensory*) to match the notes that are presented on the screen (*Challenge*). Having a toy in the centre of the pyramid does not always imply that it will be successful. However, a toy that has perceived play affordances in all four categories allows for a variety of audiences to find play value in the toy. As a side note, it might also be possible to *narrow* the audience by adding play affordances.

Most play and toys seem to lie somewhere on the edges of the play pyramid (i.e. involve two classes of play). A toy product that affords only the pure form of a play class is relatively uncommon. A toy product that significantly affords four classes of play is also rare. Figure 3 describes the six edges of the play pyramid and presents examples of play and toys that could fall on these edges. The placement is based on intended play affordance.

Table 3 Data on perceived play affordances for 23 toy products with 54 reviewers

| <i>Toy name</i> | <i>Type of play affordance</i> | <i>Count of subjects that view the affordance</i> | <i>Percentage of subjects that view the affordance</i> | <i>Toy name</i> | <i>Type of play affordance</i> | <i>Count of subjects that view the affordance</i> | <i>Percentage of subjects that view the affordance</i> |
|-----------------|--------------------------------|---|--|-----------------------|--------------------------------|---|--|
| Baby alive® | Fantasy | 53 | 98 | iDog® | Fantasy | 39 | 72 |
| | Challenge | 0 | 0 | | Challenge | 5 | 9 |
| | Construction | 2 | 4 | | Construction | 2 | 4 |
| | Sensory | 20 | 37 | | Sensory | 41 | 76 |
| Super soaker | Fantasy | 44 | 81 | Darth Vader® figurine | Fantasy | 54 | 100 |
| | Challenge | 34 | 63 | | Challenge | 2 | 4 |
| | Construction | 7 | 13 | | Construction | 3 | 6 |
| | Sensory | 19 | 35 | | Sensory | 4 | 7 |
| Juggling balls | Fantasy | 2 | 4 | Frisbee | Fantasy | 4 | 7 |
| | Challenge | 50 | 93 | | Challenge | 49 | 91 |
| | Construction | 3 | 6 | | Construction | 3 | 6 |
| | Sensory | 26 | 48 | | Sensory | 24 | 44 |
| Lego Mindstorm | Fantasy | 33 | 61 | Brio® trains | Fantasy | 44 | 81 |
| | Challenge | 53 | 98 | | Challenge | 5 | 9 |
| | Construction | 25 | 46 | | Construction | 47 | 87 |
| Mr. Potato head | Sensory | 10 | 19 | Furby® | Sensory | 11 | 20 |
| | Fantasy | 52 | 96 | | Fantasy | 48 | 89 |
| | Challenge | 3 | 6 | | Challenge | 10 | 19 |
| | Construction | 42 | 78 | | Construction | 1 | 2 |
| Toy piano | Sensory | 17 | 31 | Doll house | Sensory | 39 | 72 |
| | Fantasy | 11 | 20 | | Fantasy | 53 | 98 |
| | Challenge | 7 | 13 | | Challenge | 8 | 15 |
| | Construction | 4 | 7 | | Construction | 23 | 43 |
| 21 Questions | Sensory | 54 | 100 | Mobile | Sensory | 9 | 17 |
| | Fantasy | 2 | 4 | | Fantasy | 6 | 11 |
| | Challenge | 53 | 98 | | Challenge | 0 | 0 |
| | Construction | 1 | 2 | | Construction | 0 | 0 |
| Bratz© make-up | Sensory | 8 | 15 | Roller skates | Sensory | 54 | 100 |
| | Fantasy | 54 | 100 | | Fantasy | 3 | 6 |
| | Challenge | 2 | 4 | | Challenge | 49 | 91 |
| | Construction | 28 | 52 | | Construction | 3 | 6 |
| Glow worm | Sensory | 12 | 22 | Yu Gi Oh® cards | Sensory | 20 | 37 |
| | Fantasy | 39 | 72 | | Fantasy | 43 | 80 |
| | Challenge | 0 | 0 | | Challenge | 48 | 89 |
| | Construction | 0 | 0 | | Construction | 2 | 4 |
| Tomagotchi | Sensory | 48 | 89 | RipStik© caster board | Sensory | 2 | 4 |
| | Fantasy | 47 | 87 | | Fantasy | 2 | 4 |
| | Challenge | 39 | 72 | | Challenge | 53 | 98 |
| | Construction | 5 | 9 | | Construction | 2 | 4 |
| Nintendo DS | Sensory | 10 | 19 | Tickle Me Elmo® | Sensory | 18 | 33 |
| | Fantasy | 49 | 91 | | Fantasy | 35 | 65 |
| | Challenge | 53 | 98 | | Challenge | 0 | 0 |
| | Construction | 6 | 11 | | Construction | 0 | 0 |
| Robosaur® | Sensory | 22 | 41 | | Sensory | 52 | 96 |
| | Fantasy | 53 | 98 | | | | |
| | Challenge | 18 | 33 | | | | |
| | Construction | 9 | 17 | | | | |
| | Sensory | 14 | 26 | | | | |

Figure 3 Examples of toy products and play on the edges of the play pyramid (row 1: kaleidoscope, Whoopee Cushion®, Furby®, Teddy Bear, Disney World® Amusement Park Rides, Movies, Television, GI Joe® Action Figure; row 2: Finger Puppets, Tamagotchi®, The Sims®, Nintendo® DS, Monopoly®, Nerf® Football, Playing Cards; row 3: Crossword Puzzle, Jigsaw Puzzle, Taboo®, Jenga®, Origami, Balderdash®, Stamp Collecting, Beading Necklaces; row 4: Crayons, Foam Blocks, Play-Doh®, Sand Play, Ice Cream Ball, Finger Paint, Toy Xylophone; row 5: Jack-in-the-Box, Slip 'n Slide®, Jaw Breakers, Nickelodeon® Slime, Magic Eye®, Bop-it®, Pogo Stick, Skip-it, Juggling Balls; row 6: Doll House, Toy Make-up Kit, Mr. Potato Head®, Brio® Train Set, Lego® Blocks, Construction Blocks, Doodling) (see online version for colours)



There are several types of play, typically ones *not* involving toys that are a bit ambiguous in their placement in the play pyramid. Flirting and teasing, for example, might be considered fantasy–challenge as one is playing a game with emotions. Exploration, if it is to be considered play, might be challenge in addition to sensory, as one is testing new limits. Jokes and riddles could be challenge as they involve making non-obvious connections between seemingly unrelated things (Ludden et al., in press).

If a toy product does not have play value then it seems reasonable to say that it is not actually a toy. Designer toys are collectibles produced in limited editions and are typically vinyl or plush. The target audience for designer toys is typically adults and older teens. These items can be thought of as works of art that resemble action figures, but are not intended for fantasy play. If one happens to play pretend with them, they could be viewed as fantasy toys. If one is trying to collect a complete set, then the designer toys could be viewed as a construction or challenge toy. However, designer toys are used mostly as a means of self-expression and a means of creating an image for oneself, similar to a piece of jewellery or a painting. This begs the question: is a work of art also a toy? Huizinga would say that the product of the plastic arts does not have inherent play value and thus it would not be a toy (1950). We would say that if an object has a playful aesthetic or facade, it is not necessarily a toy product.

Oppositely, there are several products that could be playful in nature, but are not intended to be toy products. A car, for example, may have sensory or challenge play elements and a table saw may have construction, sensory or challenge play elements. A car and a table saw would not be considered toy products, but some users may refer to them as ‘toys’ if they happen to discover and embrace the play value in them (i.e. engage in fun, free movement with the given affordances). This would be a form of what we mentioned earlier as *transformed toys*.

6 The play pyramid and stages of development

The perception of play affordances depends on the age of the user. A child at age 2 may play with the same toy in a completely different manner when they are age 3; at age 4, they may not want to play with that toy at all. Twenty years later, that individual may find new play value in that same toy. Understanding age and gender differences are an important tool in toy design. The play pyramid can be used to better visualise the stages of development for designing age-appropriate toys.

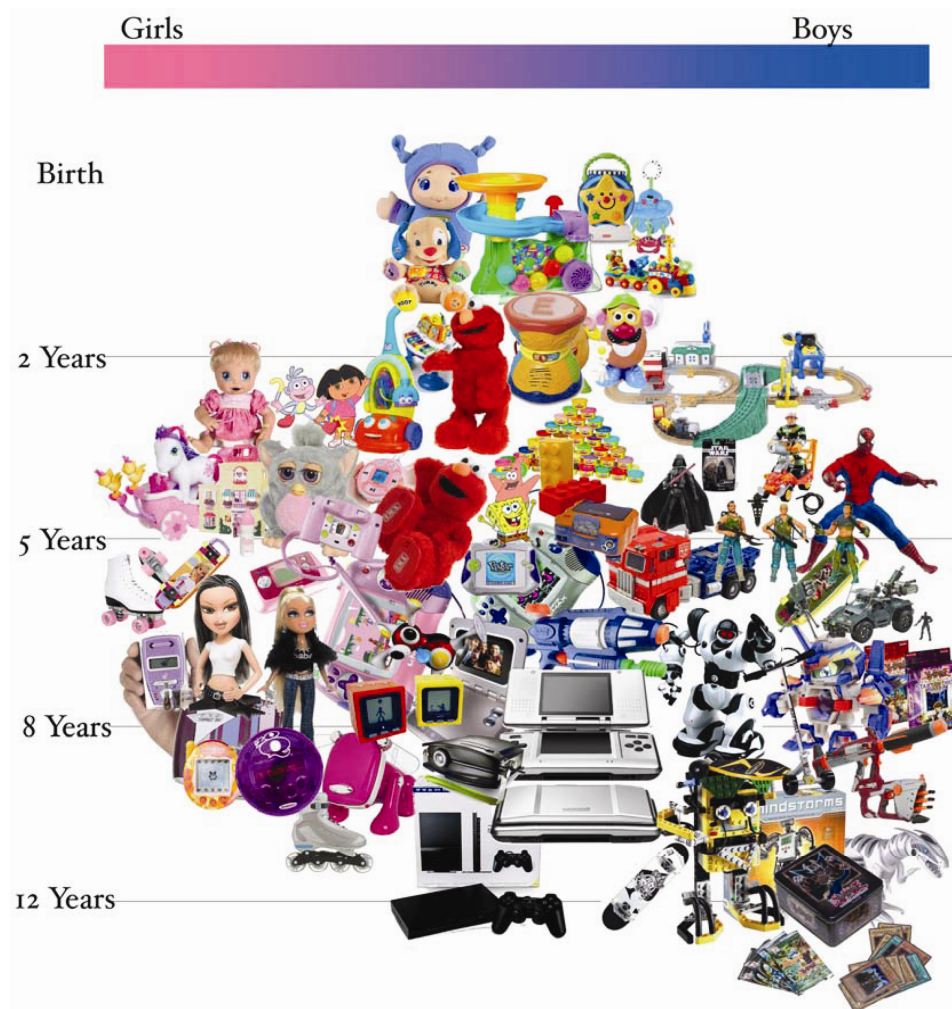
Based on reviews and ratings from websites including: Amazon.com, Hasbro.com, Mattel.com, ToysRus.com and About.com, we chose popular toy products and plotted them on a chart, shown in Figure 4, based on the manufacturer age suggestion and gender affiliation. The gender placement was influenced by research findings by Blakemore and Centers (2005).

We assigned an intended play classification to each toy in Figure 4 designated by a coloured circle with a letter corresponding to the play pyramid classification. A toy that has a play classification between categories is designated with a split colour tag and multiple letters. In Figure 5, we plotted these tags in place of the toy images to show which types of play are popular for gender and age.

These toys are only a sample of toys on the market; however, one can see trends involving play, age and gender.

We can compare these results with the age groups defined in Piaget’s developmental stages (Bee and Boyd, 2000). Granted that Piaget’s stages of development are challenged by different views, we can still use these age brackets as a backdrop for our current research.

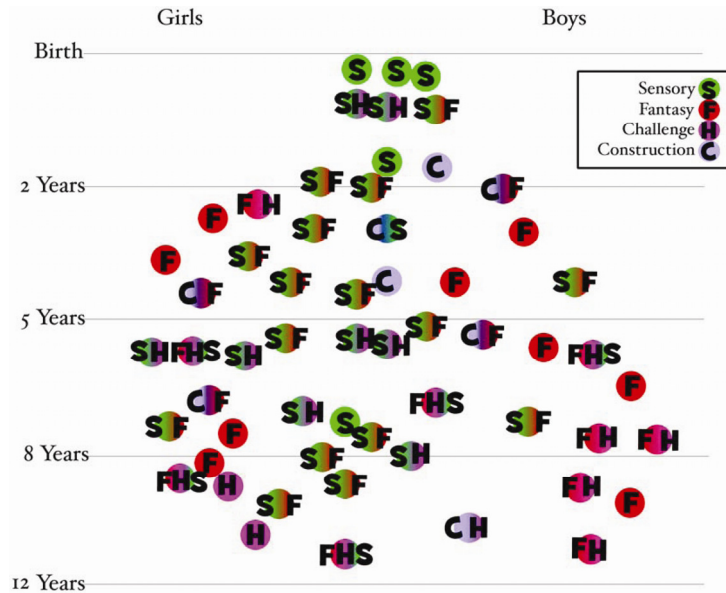
Figure 4 Popular toys of 2006–2007 for age and gender (see online version for colours)



Note: These toys are only a sample of popular toys and properties based on online review. Age placements suggested by the manufacturer. Gender placement was influenced by studies of Blakemore and Centers (2005).

Popular toys for children under the age of 18 months (both boys and girls) involve mostly toys that afford sensory play. This corresponds with Piaget’s sensory-motor stage. Children from the ages of 18 months–6 years are in Piaget’s preoperational stage. One can see in the chart that this area between the ages of 2 and 7 is largely composed of toys that afford fantasy play. Between ages 2 and 5, there are toys affording sensory–fantasy play and between ages 5 and 7, there are toys affording challenge–fantasy play. This may show a shift or transition period from learning through senses to learning through challenges all within the realm of fantasy. Children in the age range of 6–12 are in Piaget’s concrete operations stage. We see in the chart that pure challenge toys emerge here. Figure 5 is not continued through Piaget’s final formal operations stage.

Figure 5 Popular play types of 2006–2007 for age and gender (see online version for colours)



Note: This plot corresponds to the toys presented in Figure 4.

In Figure 5, we can also see other patterns related to play type and gender. Pure construction and pure sensory affordances appear to be gender neutral. Construction and sensory toys begin to be assigned a gender when they are mixed with fantasy affordances. Sensory–construction toys also tend to be gender neutral. Alternatively, pure fantasy toys tend to be gender specific. It is difficult for a fantasy toy product to be appealing to both male and female children in the preoperational stage (Blakemore and Centers, 2005). Finally, pure challenge affordances emerge in toys for children over 8 years of age, and do not seem to have a correlation with gender. Fantasy–challenge, however, is gender specific.

The play pyramid classification is used here to visualise the stages of development and how play preferences change with age and gender. Figure 5 can be used as a tool for designers to compare toy concepts to toys on the market as far as age and gender appropriateness. If similar charts are made in future years, one might see if and how play preferences change over time.

7 Applying the play pyramid in toy design industry

As an example, we will analyse a popular toy using this classification system. Nerf® Blasters from Hasbro Inc. can be described as a product line of indoor-safe projectile toys that involve foam plastic such as dart launchers and foam ball launchers. These toys typically do not involve construction play and are minimally sensory play. Most play involving the Nerf® Blasters can be placed in the middle of the challenge–fantasy edge of the play pyramid. In 2004, Hasbro Inc. began a new line of N-Strike® Nerf® Blasters including the N-Strike® Unity Power System, which allows the user to piece together

and customise their blaster (*Construction*) and an interactive DVD game (*Sensory*) to accompany some of the N-Strike® Blasters. This innovation in the product line moved Nerf® Blasters more towards the centre of the play pyramid. The N-Strike® Unity Power System was priced around 40 dollars and was more successful in the market than its predecessors, which were typically placed under the ten-dollar price mark. This demonstrates that adding play affordances can potentially add play value and can make a toy more appealing to a wider audience. The greater play value, in this case, also added monetary value to the toy product.

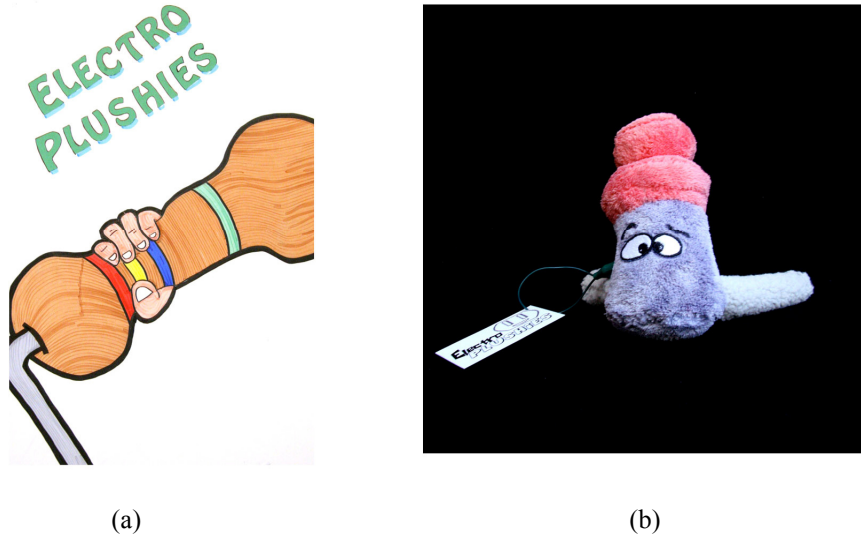
Using the scales of play we can say that Nerf® Blasters are typically highly active, highly social, free play, mostly physical and more on the male side. Sliding the scales of play will ultimately change the nature of the toy. As one can imagine with this example, sliding the scales may not be a means of making the toy ‘better’, but it can be used as an ideation technique to view the product in a new light and expand the brand into new directions. One could say that ideating with the play pyramid makes larger changes in the toy concept than ideating with the sliding scales of play.

8 Applying the play pyramid in toy design education

Mechanical Engineering course 2.00b Toy Product Design is a hands-on, project-based introduction to product design targeted at freshmen at the Massachusetts Institute of Technology (2009). In this course, students work in small teams of 5–6 members to design and prototype new toys. They are introduced to design tools and techniques as well as the product development process. Throughout the course, the students develop their own ideas from sketches to a working prototype. In the process, some concepts get discarded and some get manipulated and transformed into new and possibly better concepts. After each team proposes a toy concept in the form of a poster sometime within the first 3rd of the semester, they review the play pyramid and scales of play to see how they can alter their concept to suit different audiences or enhance the play. The most common means of idea generation used throughout this course is a technique called brainstorming as discussed early in this paper. In this case, the students brainstorm as a team with the play pyramid and sliding scales of play at their disposal. The following are a few examples of how some toy ideas have transformed during the design process by using these tools. Each example presents the original concept poster and the final working prototype.

Electroplushies are a set of anthropomorphic plush electronics components consisting of a switch, battery, resistor, LED and buzzer. Each plush toy contains the actual electrical component and can be connected with magnetic snaps at the ends of flexible arm leads. The original idea, as presented in the drawing in Figure 6(a), was suggested as a sensory–construction toy to make learning basic electronics fun for children. After reviewing Figure 5, the team decided to add more of a fantasy element to make the concept more appealing to the younger intended audience. Eventually, the team gave each component a personality reflecting their functionality. For example, the battery has an energetic personality, the buzzer has an angry disposition, and the switch, as shown in Figure 6(b), is undecided about being on or off. Electroplushies became a sensory–construction–fantasy toy.

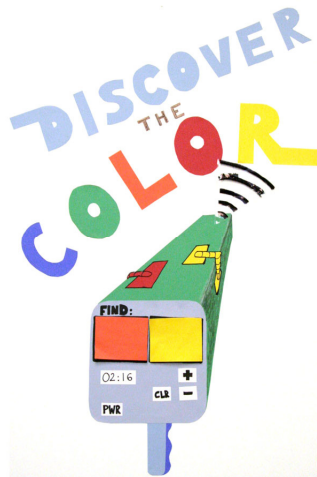
Figure 6 Electroplushies as a conceptual poster and final prototype (see online version for colours)



LUX is a toy monster that eats colours from the world and mixes them in its stomach. LUX teaches additive colour mixing (light) as opposed to the more familiar subtractive colour mixing (pigments). The original idea – Discover the Colour, as presented in the drawing in Figure 7(a) – was a toy gun that detected colours and gave challenges to find a specific colour. This concept was highly sensory and challenge. After a brainstorming session with Figure 5 and the scales of play in Figure 2(a), the team decided to make the toy for free play and moved the concept away from challenge and into the realm of fantasy and construction. The final prototype, shown in Figure 7(b) eating the blue colour of a cleaning fluid, is a sensory–construction–fantasy toy.

Eggman and Friends are a collection of six egg-shaped tops each having a ‘special power’ while spinning such as singing or illuminating. The original idea, as presented in Figure 8(a), was a challenge toy that required the user to get the Eggman spinning upright and balanced on a board. After referencing Figure 5 and brainstorming with the play pyramid and the scales of play in Figures 1 and 2, the team added a fantasy element by making the toy a set of friends each with their own personality. By giving each egg a special power, they added a stronger sensory play element as well. The challenge component remained the same. By removing the balancing board component of the toy, the toy product became more suitable for free play, and by adding the *friends* of Eggman, they added a social component. The final Eggman prototype, shown in Figure 8(b), is a sensory–challenge–fantasy toy.

Figure 7 LUX, the colour eating monster as a conceptual poster and final prototype (see online version for colours)



(a)



(b)

Figure 8 Eggman and Friends as a conceptual poster and final prototype (see online version for colours)



(a)



(b)

In some toys, play affordances were removed or changed, but in all three of these toy product examples, the overall number of intended play affordances increased. Again, we have yet to determine if higher number of play affordances correlates with 'better' toy products. More play affordances does allow for more play options, but whether that makes it a better toy is to be determined by the end user. These examples have shown that the play pyramid and the scales of play are a means of brainstorming ways of transforming and rethinking toy product concepts, which is always beneficial in the design process.

9 Conclusions

The play pyramid is a simple classification of play that can be used for identification, communication and ideation. The play pyramid identifies four fundamental types of play: sensory, fantasy, construction and challenge. Being able to plot a toy into the play pyramid is a way of helping to ensure that the toy affords play. The play pyramid in combination with the scales of play can be used as a tool for the designer to classify their ideas and compare them to existing products. Designers can also use these tools to brainstorm new toy concepts, add play value to existing toy products, and alter toy products for different users.

In testing with 54 subjects and a sample of 23 toys, the majority of toy products (~83% of the sample) were perceived to afford two or three categories of play. A small number of toy products (~8.5% of the sample) were perceived to afford only one category of play and, similarly, few toy products (~8.5% of the sample) were perceived to afford all four categories of play. We have also found that most toys for children under the age of 18 months were perceived as affording purely sensory play. Most toys for children between ages 2 and 5 were perceived to afford sensory–fantasy play. Toys for children between ages 5 and 7 were perceived to afford mostly fantasy–challenge play. Pure construction and pure sensory toys appeared to be gender neutral, while fantasy toys appeared to be gender specific.

We have found that the play pyramid is helpful in teaching toy design to students. Play is a very abstract concept and to have a physical and simple classification tool for reference helps students to bridge abstract play concepts to physical toys. Students also reference the play pyramid classifications when determining the appropriate age for a toy product concept and exploring variations of these concepts. The play pyramid may be considered too simple for generic play classification, but has been helpful in our toy product design research and toy product design education practices.

Future work may look at using spider plots to describe the play of a toy concept. Spider plots would require assigning a quantity to the play value, which might be more difficult to determine than a binary present/not present. It would be interesting to see the difference between the designer's intended play affordances and what affordances are actually perceived by the intended user. It might also be interesting to see what classification systems are developed by students if they are asked to develop a toy classification by play type without prior knowledge of other classifications.

These tools can be made into a game (perhaps digital) where, at first, a classic toy image is shown with the designer's intended positions in/on the pyramid and scales. The player then initiates a randomisation where the location in the pyramid and the position on the scales changes. The player or players are then asked, as designers, to come up with a new idea for the classic toy that takes into account the new play-type suggestions.

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