

# Tolerance of ambiguity - Its implications for creativity and design practice

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**Abstract** This paper reflects on an individual's tolerance of ambiguity and its relationship to creativity. The different ways in which people handle ambiguous situations is discussed and how tolerance of ambiguity is measured. This paper discusses the adequacy of current Ambiguity Tolerance measurement methods for the field of industrial design. We discuss how creativity and tolerance for ambiguity are integrated in a designers' life. Furthermore, the paradoxical relationship between tolerance of ambiguity as a personality trait for being creative and the statement that everyone can be creative is discussed. The paper finally presents guidelines on how to tackle tolerance of ambiguity and a proposal to make Ambiguity Tolerance measurement suitable in the field of design.

**Keywords** *Ambiguity, AT, Tolerance of ambiguity, Creativity, Design, Design practice*

## Introduction

For designers, being creative is an ever present need and ambiguity is an ever present issue to be resolved during different stages of design. Designers encounter ambiguity in design briefs, during the conceptual design phase and within design communication among multidisciplinary team members. Thus, designers are expected to deal with ambiguity and use their creativity to overcome it. However, not much is known with regards to designers' capacity for handling ambiguous situations. If designers are able to discover their tolerance for ambiguity, perhaps they can become more aware of their creative capacity related to design tasks.

Ambiguity can be described as the uncertainty in meaning or uncertainty in intention of information regarding a particular stimulus or context. Ambiguous stimuli or contexts can be interpreted in multiple ways. It differs per individual how ambiguous situations are perceived and treated. People who have intolerance of ambiguity tend to interpret an ambiguous situation as a threat or a source of discomfort (Grenier, Barette & Ladouceur, 2005). Several studies point out that an individual's tolerance of ambiguity is an important capacity of being creative (Merrotsy, 2013). Tolerance or intolerance of ambiguity is generally considered to be a personality trait (Zenasni, Besançon & Lubart, 2008) but empirical, up to date, studies on this topic are rare. Since some sources suggest that everyone can be creative (Sanders & Stappers, 2012) and if we assume that tolerance of ambiguity is an important quality for being creatively successful, it might be interesting to find a way to measure and cultivate an individual's tolerance of ambiguity, without stating that tolerance of ambiguity (AT from here onwards) is a personality trait and the only capacity for being creative.

This paper aims to answer the following questions:

what AT measurement tools do we already have and how relevant are these methods? How are AT and creativity related? Is it possible to cultivate tolerance of ambiguity? And if so, how can we do this and will this prove that people can become more creative by cultivating this AT, as suggested by Sanders and Stappers (2012)? In this paper the topic of Tolerance of Ambiguity will be reviewed, followed with a proposal to which way it can be useful to measure designers' Tolerance of Ambiguity.

## AT measurement methods

Frenkel-Brunswik (1949) was among the first to discuss tolerance of ambiguity as an emotional and perceptual personality variable. Over the past 60 years many papers on this topic refer to her research and most researchers in the tolerance of ambiguity field base their definition of tolerance of ambiguity upon her work. Frenkel-Brunswik (1949) used a cognitive test to measure AT: the Dog-Cat test (Figure 1). A picture of a dog was shown and then followed by a number of pictures representing a gradual transformation of the dog into a cat. Those who held on to the original interpretation (i.e., dog) for the longest time were considered to have lower tolerance of ambiguity (MacDonald, 1970). In the period after her research many tests became available to measure an individual's tolerance of ambiguity. Most of the AT tests are unpublished and self-report questionnaires (Furnham & Ribchester, 1995). Stanley Budner (1962) introduced the most commonly used AT measurement method, which includes 16 statements, each to be assessed on a 7 item scale. Every statement referred to the either one of the three major factors describing intolerance of ambiguity: Novelty (e.g., I would like to live in a foreign country for a while), Complexity (e.g., people who insist upon a yes or no answer just don't know how complicated things really are) or Insolubility (e.g., there is really no such thing as a problem that can't be solved). The Budner scale is used



Figure 1. 3 images from the 'Dog-Cat test', adapted from *The judgment of ambiguous stimuli as an index of cognitive functioning in aging* (p. 84) by S. J. Korchin & H. Basowitz (1956).

most frequently in tolerance of ambiguity research. This relatively old method does not seem to be substantiated by research. Although, the three dimensions are relevant for the field of design engineering if the method may be developed further. McLain (2009) also developed an AT measurement scale based upon Budner's method: the Multi Stimulus Types Ambiguity Tolerance Scale (MSTAT). He first developed the 22-item self-report scale MSTAT-I (McLain, 1993) and later on the more substantiated MSTAT-II (McLain, 2009). The MSTAT-II is a 13-item measure designed to measure AT based on five stimulus types: ambiguous stimuli in general, (e.g., I don't tolerate ambiguous situations well), complex stimuli, (e.g., I avoid situations that are too complicated for me to easily understand), uncertain stimuli, (e.g., I find it hard to make a choice when the outcome is uncertain), new/unfamiliar/novel stimuli, (e.g., I generally prefer novelty over familiarity), and insoluble/illogical/internally inconsistent stimuli (e.g., I try to avoid problems that don't seem to have only one 'best' solution). Items are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate higher ambiguity tolerance (McLain, 2009). MSTAT-II is considered the most adequate and up-to-date AT measurement method of this time.

#### *AT measurement methods under discussion*

Furnham and Ribchester (1995) are among two of the few researchers who discuss and question some frequently used AT questionnaires, such as Budner's (1962) method, and AT on itself. Furnham and Ribchester (1995) criticise the existing methods and explain: 'AT's very appeal may be part of its weakness. Rarely is a clear operational, multidimensional definition offered.' The ways of measuring AT range from projective techniques through cognitive and pen-paper questionnaires. Hence, it is impossible that all existing AT tests are truly measuring the same thing. When comparing different AT test, as done by Furnham et al., it is clear that there is no consistency in measuring the independent variable. Tolerance of ambiguity can be conceived, as stated before, as a personality trait, but also as a cognitive orientation, a perceptual defence, or an educational achievement (Furnham & Ribchester, 1995). The perception of tolerance of ambiguity and the context have to be defined to successfully measure tolerance of ambiguity and to be able to draw conclusions from it. Where Furnham criticises the existing AT measurement methods, he does not come up with a

new, ideal, method for measuring AT.

#### *The most relevant AT measurement method*

Although it may have been criticized, Budner's AT measurement method yields effective outcome. Therefore Budner's method is still inspirational for creating a more relevant AT measurement for measuring designers tolerance of ambiguity. Taking the construct of AT a step further, Herman and colleagues came up with 3 measurement challenges as the most frequent explanation given for conflicting findings regarding tolerance of ambiguity: weak psychometric attributes, potential multidimensionality and the impact of context on individual AT (Herman, Stevens, Bird, Mendenhall & Oddou, 2010) all related to the weaknesses of AT measurement tests as mentioned by Furnham et al. (1995). To tackle these challenges Herman et al. (2010) adjusted Budner's measure to twelve questions with four new dimensions: Valuing diversity in others, ability to change, challenging perspectives and coping with unfamiliarity (Herman et al., 2010). These dimensions are built into Budner's adjusted AT measurement questionnaire consisting of twelve questions, to be found in Appendix A.

This measurement of AT has also proven to be relevant for assessment in cross-cultural contexts. Herman et al.'s method (2010) does not state that tolerance of ambiguity is necessarily a personality trait, but also a quality or characteristic an individual can develop. This is interesting for our research since it implicates that AT can be cultivated, what we will discuss later. The AT measurement method of Herman et al. (2010) can be used to classify individuals on their tolerance for ambiguity. For example students who are interested in studying design. Since capacity or tolerance of ambiguity is a defining characteristic for success in the design field, it would be worthwhile performing AT assessments on design students to get a clearer understanding if there is a relation between for example their master track choice or course direction and their tolerance of ambiguity. Later in this paper we will discuss the relevance of measuring students' tendency for tolerance of ambiguity.

#### *The relation between AT and creativity*

There are many different definitions of creativity and there is no clear definition of creativity to be distinguished. Creativity overlaps with other psychological phenomena such as intelligence, cognitive style and personality, but is not identical to

any of them (Sternberg, 1988). According to Arthur Koestler (1964), every creative act involves bisociation, a process that brings together and combines previously unrelated ideas. A definition that is broad enough to cover all types of creative acts, whether in art, science or humor (Sanders & Stappers, 2012). In this paper creativity is tackled as the act of turning new and imaginative ideas into reality. Creativity is characterised by the ability to perceive the world in new ways, to find hidden patterns, to make connections between seemingly unrelated phenomena and to generate solutions. Creativity involves four levels: doing (motivated by productivity), adapting (motivated by appropriation), making (motivated by asserting ability or skill) and creating (motivated by curiosity) (Sanders & Stappers, 2012). Creativity is not only an individual trait, but is also triggered and stimulated by social, cultural and collective factors (Simonton, 2009). We will discuss the relationship between an individual's creativity and tolerance of ambiguity. Other factors influencing creativity will not be taken into account. We will treat AT as a capacity of creativity.

Tolerance of ambiguity is significantly and positively related to creativity. This statement is partly based on the idea that situations that require creative thinking often involve ambiguity (Zenasni, Besançon & Lubart, 2008). In many sessions to facilitate, support and provoke creative thinking, toolkits containing of ambiguous elements are used. Creativity is fostered by having a choice of spaces in which to explore (Sanders & Stappers, 2012). Triggers to stimulate creativity are almost always characterised by multiple meanings and ambiguous items in creative toolkits have proven to provoke the most useful responses. An often used example of a test in a creativity enhancing toolkit is done with a paperclip. The participant is presented with a paperclip and has to come up with as many possible ways in using it as possible. The paperclip is in this set up used as an ambiguous object (Figure 2).

Studies have also shown that individuals with a high tolerance of ambiguity have professions characterised by a high degree of freedom. Ambiguity tolerant people are more likely to be inclined toward creative fields of work. Also, tolerance of ambiguity seems to be related to personal traits and abilities that are desired in creative professions (Stoycheva, 2003). On the other hand, exercising a creative profession may develop one's abilities to cope with ambiguity (Stoycheva, 2003). This statement suggests that tolerance of ambiguity can be cultivated and triggers further investigation in this area.

### *Cultivating tolerance of ambiguity*

#### *The possibilities of cultivating tolerance of ambiguity*

It is expected that if you can cope with the grey area that comes with an ambiguous problem definition, you tend to be more creative and come up with more creative solutions. In other words, if you are able to tolerate ambiguity, you are more likely to succeed creatively, also in uncertain or vague situations. With practice, people can develop a higher tolerance of ambiguity. Knowledge, skills and attitudes which help



Figure 2. 'Ways to use a paperclip', adapted from <http://thesecretyuniverse.wonderhowto.com>.

people to cope with uncertainties in life have always been part of humanity. This knowledge, skills and attitudes are acquired by individuals through education. Therefore, education and training that one has received are important for their tolerance for ambiguity. Empirical data confirm this expectation: university students have higher ambiguity tolerance than their contemporaries who are not enrolled in university (Stoycheva, 2010). The studies on creativity also indicate that knowledge can make it much more easy to tackle novel and complex tasks (which are ambiguous). The type of education has also an important relationship with ambiguity tolerance. Research shows that studies in arts outscore those from the business and the medical and technical universities (Stoycheva, 2003).

The question remains whether individuals who are more tolerant to ambiguity choose such creative studies or if they learn to be more tolerant towards ambiguity during their study. What we do know is that using ambiguity in a creative challenge seems favouring ambiguity tolerance more than the group adherence to structured anonymous knowledge. Stoycheva (2003) performed a study that showed that the AT difference between students in arts and students in medicine is small and statistically negligible in the first year and significant at the end of their higher education cycle. These findings indicate that the type of education as well as the expertise gained during education are important factors for the development of ambiguity tolerance (Stoycheva, 2003). The research of Stoycheva mainly suggests that it is possible to cultivate tolerance of ambiguity. This is a relevant fact in teaching at universities and especially design schools. If universities are able to teach design students a way to be more open to ambiguity, they will probably become more creative and gain better results.

#### *Ways of cultivating tolerance of ambiguity*

Now we know that it is possible to cultivate ambiguity, it is most relevant to find out how to do this. Cultivating tolerance of ambiguity will not only make us more creative, but also helps us to deal with ambiguous situations and take bigger risks. One of the universities that acknowledges the importance of tolerance of ambiguity of their students is the University of Minnesota Rochester (UMR). In their curriculum they offer a course to teach students in understanding and pushing through the tolerance of



ambiguity. Aaron Kostko, an UMR lecturer in philosophy says that “To help facilitate students’ conceptual understanding and knowledge acquisition, educators must teach students how to be able to recognise and react appropriately to ambiguous information and situations” (University of Minnesota Rochester, 2015). UMR is still working on shaping its AT cultivation course, but acknowledges its necessity. In the next paragraph some tips on cultivating a higher tolerance of ambiguity will follow.

#### *Tips on cultivating a higher ambiguity tolerance*

By combining different literature on AT, we shaped some useful tips on generating a higher tolerance of ambiguity. These tips can be used in design processes and to teach in a design curriculum. Three guidelines in making an individual more tolerant towards ambiguity and thus more creative in everyday life:

1. **Let go control.** Individuals like to feel in control over situations, projects, the things they are doing and the life they are living. If you force yourself to let go this feeling of control, you will become open to more uncertain, thus ambiguous situations. To deal with ambiguity you need to be comfortable with uncertainty. Allow yourself and the things around you to be messy. The creative process will never be structured and/or in control.
2. **Be curious.** Try to act curious in every situation. Do not take situations as they are but always look for what is behind the things that happen. Induce judgement and avoid assumptions. Try to take an open minded stance about what is happening around you. Ask many ‘why’ questions to get to the core of for example the design problem. Listen to advice and try to listen to your own voice and ‘gut feeling’.
3. **Experiment.** Try as many options and ideas as possible and play with them. Act without the complete picture and learn by trial and error. Take time and don’t try to shortcut the creative process. Do not get annoyed by too many questions and not enough answers.

We set up these guidelines by combining different literature. When keeping these guidelines in mind at the moment of -or before- facing ambiguous situations or problems, people might be able to overcome their preliminary, and perhaps, adverse reaction towards ambiguity and cope with the situation as it is. As a result, people may be able to solve problems they struggle with and find their way out of uncertain, sometimes even uncomfortable, situations. On the following section how to combine tolerance of ambiguity, creativity and applying this in the field of design will be discussed, based on the insights retrieved by this paper.

#### *Using AT in the field of design*

So far we have shown a strong and relevant link between tolerance of ambiguity and creativity and provided evidence that we can measure and cultivate AT. It is clear that in the field of design, being creative is one of the most important assets. Almost all creative people must learn to tolerate ambiguity and incompleteness for the creation of their products.

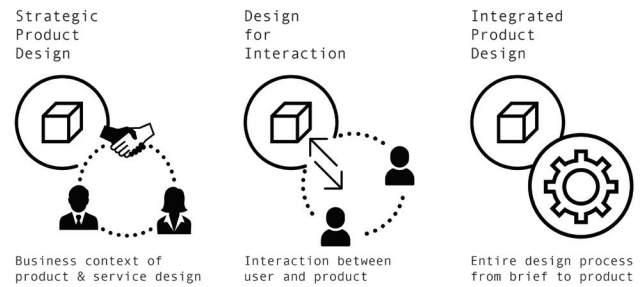


Figure 3. Master tracks of Industrial Design Engineering, TU Delft.

Furthermore, even in the field of design, there are varying degrees of ambiguity or abstraction employed. Because there are methods available to measure AT, we can use them to classify individuals, such as design students, on their capacity of ambiguity tolerance. When doing so, it is possible to spot which group needs more help to generate tolerance of ambiguity to stimulate their creative process. Moreover there is the opportunity to create groups and teams based on people’s tolerance of ambiguity. These groups could have mixed individuals with a high AT and with individuals with low AT. When doing so, we might have many different outcomes for the same problem definitions, varying from extremely creative to pragmatic. We can classify design students on their tolerance of ambiguity and connect them to suitable courses or even master tracks. For example, in the Faculty of Industrial Design Engineering at the TU Delft, a distribution between individuals could be made between the three master tracks (Figure 3) based on AT. We could state that the three master tracks are characterised by more or less ambiguous situations during their curriculum. Design for Interaction is centred around designing experiences and interactions. Embodiment is secondary to conceptualisation and thus we could say this master track faces more ambiguous design challenges. Integrated Product Design, on the other hand, is focused on embodying and prototyping the design brief rather than conceptualising and thus designers face less ambiguity during the design process. Strategic Product Design, focussing on the business context of product and service design, floats in the middle of the three master tracks when it comes to designing with ambiguity. More elaborate research has to be done on how much the three master tracks actually differ in terms of ambiguity and how the designers in the different area’s cope with ambiguity.

In functional product design, designing an ambiguous product is often not acceptable (Gaver, Beaver & Benford, 2003) but in interaction design or experience-driven design, ambiguity may be a desirable attribute. Thus, designers with low or high AT could be distributed over different tasks to tackle issues such as ambiguity, familiarity, ease of use, cognitive comfort, safety, poetic design in order to decide whether ambiguity is desirable or should not interfere with the accomplishment of well-defined tasks, particularly in safety-critical environments (Gaver, Beaver & Benford, 2003). We strongly agree with Gavers view on ambiguity: ‘ambiguity is a powerful

design tool for raising topics or asking questions, while renouncing the possibility of dictating answers. By virtue of this balance, ambiguity both offers an inspiring resource to designers and shows a deep respect for users.' (Gaver, Beaver & Benford, 2003).

## Conclusions

There is still much research that needs to be done in the field of ambiguity in relation to designers' creativity. The existing methods to measure AT are almost outdated. The most relevant tool to measure AT is the 12 item scale of Herman, Stevens, Bird, Mendenhall & Oddou (2010), which is still built upon the early Budner (1962) scale. It is worth exploring a new way to measure AT in order to further explain the relation between creativity and tolerance of ambiguity in the field of Industrial Design. What we do know is that tolerance of ambiguity is not only a personality trait and that it is possible to cultivate a higher tolerance of ambiguity. With AT considered as a capacity of creativity an individual designer can be more creative when cultivating a higher AT. We can state that any designer is able to tolerate ambiguous situations or problems and thus can be more creative. We conclude with the note that tolerance of ambiguity is a valuable resource for designers. Education in this field can make a difference in cultivation of ambiguity in design students, selection or selection of students with high tolerance of ambiguity and/or support the development of tolerance of ambiguity to support their creativity.

### Recommendation for further research

This paper was a theoretically reflection on ambiguity and its relation to creativity. However, further empirical evidence is needed to support our conclusions. Our future plans include the following. We plan to facilitate a creative workshop to see how the established guidelines to cultivate AT can help an individual to solve a design problem. The following research question can be answered: is it easier to solve a design problem when being more open for ambiguity? In addition, we will perform the AT measurement test of Herman et al. (2010) (Appendix A) on design students from the different master tracks at TU Delft: Strategic Product Design, Design for Interaction and Integrated Product Design to see if there is a significant difference in the students' tolerance of ambiguity between the three master directions. The following research question will be tackled: is there a significant difference in the students' AT between the master tracks? And how can we use this information to guide students towards a better study choice or during their studies?

Furthermore, we will perform the AT measurement test of Herman et al. (2010) (Appendix A) on design students in their bachelor to see if it is possible to make a more substantiated choice for their master track based on their tolerance for ambiguity. Finally, to perform these tests a new design relevant AT questionnaire needs to be developed especially for design students with questions which focuses on designers' problem solving skills, communication skills, creation skills, etc.

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### **APPENDIX A - Tolerance of ambiguity 12 item scale Herman, Stevens, Bird, Mendenhall & Oddou (2010)**

Items included in final measure:

1. I avoid settings where people don't share my values. [Reverse Coded]
2. I can enjoy being with people whose values are very different from mine.
3. I would like to live in a foreign country for a while.
4. I like to surround myself with things that are familiar to me. [Reverse Coded]
5. The sooner we all acquire similar values and ideals the better. [Reverse Coded]
6. I can be comfortable with nearly all kinds of people.
7. If given a choice, I will usually visit a foreign country rather than vacation at home.
8. A good teacher is one who makes you wonder about your way of looking at things.
9. A good job is one where what is to be done and how it is to be done are always clear. [Reverse Coded]
10. A person who leads an even, regular life in which few surprises or unexpected happenings arise really has a lot to be grateful for. [Reverse Coded]
11. What we are used to is always preferable to what is unfamiliar. [Reverse Coded]
12. I like parties where I know most of the people more than ones where all or most of the people are complete strangers.

[Reverse Coded]

Note: All items are scored on a 5-point Likert scale, ranging from "1 = Strongly Disagree" to "5 = Strongly Agree" and a "3 = Neither Agree nor Disagree" option in the middle. (This scoring pattern is inverted for items followed by [Reverse Coded], above.)