Perceptions of Creativity

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Dedication

This thesis is dedicated to everyone who sees and believes that creative endeavors are an important and essential part of life.

Abstract

This study examines the perceptions of how creative various activities are believed to be. Forty-eight survey items were created modeling Kaufman and Beghetto's four C model of creativity. Principal factor analysis was conducted to identify factors within each of the four groups. The data analysis indicates that the four C categories are not unifactor and that there may be a number of different influences that affect perceptions of creativity.

Keywords: creativity, perceptions, creative activities, four C

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Introduction

Defining creativity has been one of the major tasks in creativity research (Plucker, Beghetto, & Dow, 2004; Kaufman & Beghetto, 2009; Sawyer, 2012). Stein (1953) wrote the standard and generally accepted definition: “A creative work is a novel work that is accepted as tenable or useful or satisfying by a group in time.” One study found that, of 90 articles that included the word “creative” in the title, only 38% provided an explicit definition, 41% provided an implicit definition, and 21% had no definition (Plucker et al., 2004). The lack of an accepted and agreed upon definition of creativity has had a great effect on the ability to study the topic.

Definitions of creativity may also contain terms that are not easily defined. Usefulness is a common description of creativity, but it is difficult to operationalize. In open-ended interviews, words such as appropriateness, novelty, thoughtfulness, interestingness, and cleverness were identified as criteria for rating creativity (Diedrich, Benedek, Jauk, & Neubauer, 2015). They also found that creativity was strongly related to novelty and moderately related to usefulness.

Kaufman and Beghetto (2009) proposed the Four C model of creativity that includes the categories, from least to most creativity, mini-c, little-c, pro-C, and Big-C. The focus for most studies of creativity has been Big-C, genius level creativity, and little-c, individual level creativity. Kaufman and Beghetto proposed that there is a professional level of creativity, which is not quite the genius, or Big-C, level, and that there is also a personal, mini-c, level of creativity which has meaning solely for ourselves.

One of the most important characteristics of mini-c is that the creativity experience by the individual does not need to be novel, original, or meaningful to others. A small child learning simple insights would be classified as creativity. Another example is an "aha" moment experienced while learning a new skill. What may have been learned is not necessarily new to others or society but it is new to the individual. Another important aspect of mini-c is that it reinforces the important relationship of creativity and learning. Beghetto and Kaufman (2007) explain that "this is not to say that learning is creativity, but rather that knowledge development and later forms of creative expression (e.g., little-c and Big-C) have their genesis in mini-c interpretations."

Kaufman and Beghetto (2013) completed a study looking at layperson perceptions of the Four C categories. The survey consisted of sixteen items from five categories: not creative, mini-c, little-c, pro-C, and Big-C. The results of the study indicated that people could distinguish among the Four Cs; however, the categories of pro-C and little-c were less distinguished.

Puente-Diaz, Maier, Brem, & and Cavazos-Arroyo (2013) replicated that study within a Mexican community and a German community to examine if the Four C model differs across cultures. What was found was that both the Mexican and German communities recognized the Four Cs. Unlike Kaufman and Beghetto, they found a distinction between pro-C and little-c. Another interesting aspect of this study was that, in these two groups, little-c was found to be less creative than that of the mini-c category.

The Four C model has had proponents and opponents. Among the opponents is Runco (2014) who argued that, while you can look at the different high outcomes of creativity, such as fame and reputation, the process of creativity that produces those four forms of creative outcomes is the same.

He also argues against the Four C model stating that it “may seem to be a good idea in the sense that it is a bit more sensitive, just as a scale with a large number of levels” (Runco, 2014). He believes that acknowledging the continuity of creativity would allow for greater research in creativity to be accomplished. Beghetto and Kaufman (2015) defended the Four C model by saying that the four categories were not meant to be rigid.

Other researchers have examined creativity using other categories. Stoltzfus, Nibbelink, Vredenburg, and Thryrum (2011) examined gender and gender roles, and how these are related to creativity. Khazanchi and Masterson (2010) developed a multi-foci social exchange model of creativity. Another, more widely known creativity model is that of Mihaly Csikszentmihalyi, who formulated the Systems Model of creativity. The Systems Model of creativity connects creativity to many other topics such as education, responsibility, art, and life span (Csikszentmihalyi, 2015). The work done to interconnect the topics is admirable and useful despite the paucity of examining creativity in itself.

While there has been research done on specific activities and products regarding creativity, there has been little done looking at universal conceptions of creativity. As with models of creativity, it was difficult to locate studies that examined the creativity of an activity rather than a specific product. For example, a study may be found that examines the creativity of an artist’s painting but studies that examine how creative people believe painting as an activity are more difficult to find. The goals of this study were to examine the beliefs that people hold about the creativity of activities and to compare findings with Kaufman and Beghetto’s Four C model.

Methodology

Study 1

Participants

Study 1 included 61 participants. Participants identified their race as White/Caucasian (*n* = 53, 86.9%), Hispanic/Latino (*n* = 2, 4.5%), American Indian/Alaskan Native (*n* = 1, 1.6%), Asian (*n* = 1, 1.6%), Black/African American (*n* = 1, 1.6%), Native Hawaiian/Pacific Islander (*n* = 1, 1.6%), and Other (*n* = 3, 4.9%). Ages ranged from 15-83 ($n = 59$, $\mu = 37.9$). The participants identified themselves as students (*n* = 23, 37.7%) or non-students (*n* = 37, 60.6%).

Procedure

A 48-item survey was designed to gather data. The survey was distributed online and anyone who had access to the link to the survey could participate. Eight blocks of six items each were randomized and the blocks were distributed across three pages. The participants were asked to rate each of the 48 items as one of the following: "Extremely creative", "Very creative", "Creative", "Somewhat creative", and "Not at all creative".

Survey items. Each of the items was designed to represent an example of a creative activity that was in line with one of the four levels of creativity in the Four C Model of Creativity (Kaufman & Beghetto, 2009). In Table 1, items represent Big-C (1-12), pro-C (13-24), little-c (25-36), and mini-c (37-38).

Analysis. Response patterns with missing data were eliminated. The resulting sample size was too small to conduct a complete factor analysis of all 48 items. However, the resulting sample size was sufficient to conduct principal factor analysis of each category of items. Scree plots were generated to examine the eigenvalues of the factors to determine whether each category of items is unifactor or not. Principal axis factoring with varimax rotation identified the least number of factors, which can account for the common variance among the items in a category. Maximum likelihood factor analysis (MLFA) was used to test different factor structures for each category of items.

The student data for each of the four categories of items was subjected to two forms of analysis: (1) exploratory analysis involving principal component analysis, principal axis factoring with varimax rotation, and scree plot examination; and (2) confirmatory analysis involving the chi-square goodness-of-fit test in MLFA. Both forms of analysis were used to investigate the factor structure of each category of items and to determine the extent to which the items in each category are unifactor.

Results

Table 1 displays the means of all items in categorical order. Items represent Big-C (1-12), pro-C (13-24), little-c (25-36), and mini-c (37-38).

Big-C Category. We examined the first 12 items, representing the Big-C category. There were two factors indicated by the scree plot in Figure 1 and the eigenvalues (≥1) indicated in Table 2. The scree plot shows a strong first factor, a smaller secondary factor, and a smooth relatively flat slope for subsequent eigenvalues. The scree plot indicated that there are two factors that explain the variance in the Big-C categories. The principal component analysis determined that first two factors account for 55.5% of the common variance.

Table 3 displays results of a principal axis factoring with varimax rotation of the

Big-C category data and indicated which of the items have large loadings with the two extracted factors. Large loadings (≥ .7) indicated which items were associated with the factors. Factor 1 has large loadings with "Writing a novel that becomes a classic" and "Painting a work of art that becomes recognized worldwide". Factor 2 has large loadings with "Designing a method of manufacturing that is adapted throughout the world" and "Designing a tool that becomes a necessity of all construction workers' toolbox".

The chi-square goodness-of-fit test in the MLFA indicates that the hypothesis for a unifactor structure is rejected (χ^2 = 93.73, df = 54, p < .001); whereas, the hypothesis for a two-factor structure is not rejected (χ^2 = 56.20, df = 43, p < .085). This result provided support for a two-factor model.

In fact, both the confirmatory analysis and the exploratory analysis of this item data provided support for a two-factor structure and no support for a unifactor structure for the Big-C items.

Pro-C Category. Table 4 indicates that the items in the pro-C category have eigenvalues greater than one revealed four factors that account for 72.7% of the variance. The scree plot, Figure 2, reveals a slightly more prominent drop in components than in the Big-C category but still displays a sharp decline. Table 5 provides results from the principal axis factoring with varimax rotation. Items with high factor loadings indicate that there is one item associated with each factor. Factor 1 has a large loading with "Creating a product which cleans more efficiently and becomes widely used". Factor 2 has a large loading with "Painting a large, highly visible mural". Factor 3 has a large loading with "Directing an award-winning independent film". Finally, factor 4 has a large loading with “Combining new spices and ingredients into a BBQ sauce that wins a blue ribbon at the local fair”.

The chi-square goodness-of-fit test in MLFA indicates that the hypotheses that the category items are unifactor or tri-factor are rejected (χ^2 = 125.19, *df* = 54, $p < .000$; χ^2 = 55.75, *df* = 33, $p < .008$); whereas, the hypothesis that the category items have a four-factor structure is not rejected (χ^2 = 25.86, *df* = 24, $p < .360$). The hypothesis that the category items are bi-factor was not tested, because the computation of the chi square statistic required more iterations (> 25) than the program allowed. This test result provided support for a four-factor model.

Both the exploratory analysis and the confirmatory analysis of this item data provided evidence in support of a four-factor structure but no evidence in support of a unifactor structure for the pro-C items.

Little-c Category. Table 6 indicates that the little-c category items had four factors with eigenvalues greater than one that accounted for 69.16% of the variance. The scree plot, Figure 3, displays a slope with no distinct drop. Four factors were identified through principal axis factoring with varimax rotation, as indicated in Table 7. Factor 1 has a large loading with “Creating an original quilt design”. Factor 2 has a large loading with “Testing different instruments and the combination of sounds in a high school band”. Factor 3 has a large loading with “Designing a model of a bridge using only matches and glue”. Lastly, factor 4 has a large loading with “Using a strategy in a game that does not seem to be effective but is”.

The chi-square goodness-of-fit test in the MLFA indicates that the hypothesis for a unifactor structure is rejected (χ^2 = 88.87, *df* = 54, *p* < .002), but that the hypothesis for a bi-factor structure is not rejected (χ^2 = 52.52, *df* = 43, *p* < .152) and that the hypothesis for a three-factor structure is not rejected (χ^2 = 28.90, *df* = 33, *p* < .671). The hypothesis that the category items have a four- factor structure was not tested, because the computation of the chi square statistic required more iterations (> 25) than the program allowed. This confirmatory analysis provided support for a bi-factor model as the simplest model for this category of items.

Although the exploratory analysis and the confirmatory analysis of this item data led to different conclusions regarding the factor structure of the items, both methods of analysis indicated that the little-c items are not unifactor.

Mini-c Category. Four factors were determined for the mini-c category as well as seen in Table 8. The four factors accounted for 70.75% of the common variance in the category. Once again, the scree plot, Figure 4, displays a distinctive slope. There appears to be a small drop off after factor 4, reflecting the four factors with eigenvalues over one accurately.

Principal axis factoring with varimax rotation, Table 9, identified four factors. Factor 1 has large loadings with “Using a tool for an effective yet unintended purpose” and “Using an unexpected item in a new way”. Factor 2 has a large loading with “Expressing the desire to be an astronaut veterinarian when grown up”. Finally, factor 3 has a large loading with “Determining that a chair will fit through a door if turned to another direction”. The principal axis factoring with varimax rotation did not reveal any item with a large factor loading with factor 4.

The chi-square goodness-of-fit test in the MLFA indicates that the hypothesis for a unifactor structure is rejected ($\chi^2 = 93.65$, $df = 54$, $p < .001$), but that the hypothesis for a bi-factor structure is not rejected ($\chi^2 = 53.15$, $df = 43$, $p < .138$), that the hypothesis for a three-factor structure is not rejected ($\chi^2 = 33.49$, $df = 33$, $p < .444$), and that the hypothesis for a four-factor structure is not rejected ($\chi^2 = 15.95$, $df = 24$, $p < .890$). Overall, this confirmatory analysis provided support for a bi-factor model as the simplest model for this category of items.

Although the exploratory analysis and the confirmatory analysis of this item data indicated different factor structures for these items, both analyses indicated that the mini-c items are not unifactor. This result was similar to the result reached for the little-c items.

Study 2

Participants

Study 2 included 83 participants. Participants identified their race as White/Caucasian ($n = 73$, 88%), Hispanic/Latino ($n = 3$, 3.6%), American Indian/Alaskan Native ($n = 3$, 3.6%%), Asian ($n =5$, 6%), Black/African American ($n = 1$, 1.2%), Native Hawaiian/Pacific Islander ($n = 1$, 1.2%), and Other ($n = 1$, 1.2%). Ages ranged from 12 to 80 ($n = 82$, $\mu = 34.1$). The participants identified as students ($n = 33$, 39.8%) and non-students ($n = 50$, 60.2%). Fifty-seven participants identified as female (68.7%), 20 as male (24%), 1 as transgender (1.2%), and 3 as non-binary (3.6%).

Procedure

Study 2 was conducted in an almost identical format to Study 1. The items in Study 2 were further randomized, spread across two pages instead of three, and a question asking for participant gender was added. The survey continued to be available to anyone who had access to the web address.

Results

Big-C Category. Three factors were identified for the Big-C category in experiment 2 as seen in Table 10. These three factors account for 63.54% of the common variance in the group. The scree plot, Figure 5, displays very little distinction among components. Principal axis factoring with varimax rotation, Table 11, identified three factors. Factor 1 has large loadings with "Creating a new building material used around the world" and "Designing a tool that becomes a necessity of all construction workers' toolbox". Factor 2 has a large loading with "Designing a large monument that is recognized worldwide". The principal axis factoring with varimax rotation reveals no item with a large loading with factor 3.

The chi-square goodness-of-fit test in MLFA indicates that the hypotheses that the category items are unifactor, bi-factor, and three-factor are rejected ($\chi^2 = 157.77$, $df = 54$, $p < .000$; $\chi^2 = 86.03$, $df = 43$, $p < .000$; $\chi^2 = 56.99$, $df = 33$, $p < .006$). This confirmatory analysis provides no support for a three-factor structure for these items as indicated by the prior exploratory analysis.

In addition, neither the exploratory analysis nor the confirmatory analysis of this item data produced evidence to support the view that the Big-C items are unifactor.

Pro-C Category. Principal component analysis, Table 12, reveals four factors for the pro-C category that account for 62.31% of the variance. Once again, the scree plot, Figure 6, lacks a distinctive drop that would indicate the number of factors more clearly. Table 13 displays principal axis factoring with varimax rotation for the pro-C category.

Factor 1 has large loadings with "Directing an award-winning independent film" and "Playing sold-out shows with a unique sounding instrument at small clubs". Factor 2 has a large loading with "Designing a water bottle that produces less waste and ships more effectively" and Factor 3 has a large loading with "Selling paintings locally that use a new artistic technique". Factor 4 lacks large loadings with any items.

The chi-square goodness-of-fit test in the MLFA indicates that the hypotheses for a unifactor and bi-factor structure are rejected (χ^2 = 103.56, df = 54, p < .000; χ^2 = 62.13, df = 43, p < .030), but that the hypothesis for a three-factor structure is not rejected (χ^2 = 46.03, df = 33, p < .065). Overall, these analyses provided no support for a unifactor structure for the items.

Little-c Category. Four factors were identified for the little-c category in experiment two, Table 14. These factors account for 61.18% of the common variance in the group of items. Much like most of the other categories, the little-c category displays an evenly sloped scree plot as seen in Figure 7.

Principal axis factoring with varimax rotation is displayed in Table 15. Factor 1 has a large loading with "Experimenting with natural fabric dyes to color a shirt". Factor 2 has a large loading with "Designing a model of a bridge using only matches and glue". Factor 3 has a large loading with "Using a strategy in a game that does not seem to be effective but is" and Factor 4 has a large loading with "Creating a three-dimensional map of a fictional land".

The chi-square goodness-of-fit test in the MLFA indicates that the hypotheses for a unifactor and bi-factor structure are rejected (χ^2 = 105.26, df = 54, p < .000; χ^2 = 62.16, df = 43, p < .029), but that the hypothesis for a three-factor structure is not rejected (χ^2 = 34.56, df = 33, p < .393). This confirmatory analysis provided support for a three-factor model.

In summary, the exploratory analysis and the confirmatory analysis of this item data indicated different factor structures for these items and both analyses indicated that the little-c items are not unifactor.

Mini-c Category. Principal component analysis, Table 16, shows that three categories were determined for the mini-c category and accounted for 55.37% of the variance in the group. Once again, the scree plot, Figure 8, shows a distinctive slope. There is a small drop off after factor 3, reflecting the three factors with eigenvalues over one accurately. Principal axis factoring with varimax rotation, Table 17, shows the factor loadings. Factor 1 has a large loading with "Discovering that mixing red and yellow paint produces orange in an elementary art class". Factor 2 has large loadings with "Using an unexpected item in a new way" and "Using a tool for an effective yet unintended purpose". The principal axis factoring with varimax rotation reveals no item with a large loadings with factor 3.

The chi-square goodness-of-fit test in the MLFA indicates that the hypothesis for a unifactor structure is rejected (χ^2 = 98.42, df = 54, p < .000) and that the hypothesis for a bifactor structure is rejected (χ^2 = 61.37, df = 43, p < .034) but that the hypothesis for a three-factor structure is not rejected (χ^2 = 30.71, df = 33, p < .582).

Both the exploratory analysis and the confirmatory analysis of this item data provide support for a three-factor structure but no support for a unifactor structure for the mini-c items.

Discussion

None of the item categories in either of the experiments were unifactor. Unifactor structures for the item categories would provide empirical evidence that the Four C model is a viable model of creativity. The analyses of item data in this inquiry are not supportive of the Four C model.

The items that have large loadings with specific factors differ between the two participant groups. This indicates that there are differences between the two participant groups. With a larger sample size, we would be able to examine all Four Categories together, which may allow us to find factor patterns across all the items.

Kaufman and Beghetto (2015) explain that the Four C model was not created to be a clear-cut classification of creativity. The current study has reflected that. We can see from an examination of the means of each of the groups in Table 1 that the group means rank highest on the Big-C items, followed by the pro-C, little-c, and mini-c groupings respectively. This provides support for the hierarchy of the proposed Four C categories; whereas, the lack of unifactor item categories indicates that there may be more than four factors at play in determining the creativity of an activity.

Creativity continues to be elusive to study. The activities that people find to be creative and how creative those items are largely, empirically unknown. A standard definition of creativity is essential for the continued study of the field, but it is very important that the definition is inclusive. If a standard definition lacks acknowledgement, for example, to mini-c style creativity, then the studies could miss out on a wealth of information.

The ability to recognize and measure all levels of creativity is an important task for many fields and education, in particular. Creativity allows thinkers to think outside-the-box. Today, there are many problems in need of creative solutions. By recognizing and measuring levels of creativity, teachers may be able to help those that struggle with creativity and challenge those that excel.

This study suggests that the Four C model of creativity has some merit in categorizing the creativity of an activity. The means show a gradual increase in creativity from mini-c to Big-C in both studies. This demonstrates that there are some activities that people view as more creative than others. However, the categories were not found to be unifactor in structure. In academic or other settings, the Four C model would not be useful as a measurement of creativity, which was not the original intent. This does raise the question of how to create an assessment tool to help people recognize and nurture their creative thinking patterns, activities, and products.

There is still much work to be done to move the study of creativity forward. Once a proper, agreed-upon definition is determined, it will be much easier to examine and measure the creativity of different actions and products. Creativity appears to be a universal trait, although different cultures may view creativity in different ways. Despite this, people seem to be able recognize creativity in things such as a sudden insight, a novel idea, or a unique product when they see it. A standardized definition, such as Stein's (1953) is useful for research, but it may discount the views of the general population and miss out on creative activity that is not covered by the definition.

A larger sample size would have allowed us to conduct factor analysis on the survey items without breaking the survey items into the categories for which they were designed. While the item categories were not unifactor, there may be different and interesting results gathered from viewing all the items together.

In future studies, it would be beneficial to see what words are associated with creativity. Examining what words act as a trigger for a person to consider an activity to be creative would be quite interesting. This would allow for the examination of the actions that people consider creative rather than the more common examination of products or outcomes. Once a more inclusive, standardized definition of creativity is established, there will be more accurate ways to measure the perceptions of creativity. Studies should be continued to examine just what people believe creativity is. Care should be taken to examine differences in populations such as age, gender, and culture. It may turn out that beliefs concerning creativity are different among groups.

It is important to find an inclusive, comprehensive definition and model of creativity. Research based on the current standardized definition of creativity may have results that lack the depth and complexity that is the entirety of creativity. There is still much that can be learned about what creative activities are and how we can measure creativity in a productive and meaningful way.

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Tables

Table 1

Means & Standard Deviations

	Items	Study 1		Study 2	
		M	*SD*	*M*	*SD*
1.	Creating the world-wide web	4.25	1.04	4.22	0.98
2.	Designing a building that filters smog from the air and improves the air quality in a large area	4.26	0.84	3.98	0.98
3.	Creating a new guidance technique that is replicated in schools around the world	3.46	0.94	3.5	0.96
4.	Writing a novel that becomes a classic	3.72	0.97	3.84	0.92
5.	Discovering the best way to market a product to a world-wide market	3.18	0.90	3.29	1.07
6.	Designing a large monument that is recognized worldwide	3.61	0.92	3.77	0.85
7.	Creating a new popular musical style	4.02	0.92	3.96	0.87
8.	Designing a method of manufacturing that is adapted throughout the world	3.51	0.91	3.81	0.90
9.	Painting a work of art that becomes recognized worldwide	3.79	0.84	3.86	0.98
10	Creating a new building material used around the world	3.98	0.94	3.95	1.05
11.	Designing a tool that becomes a necessity of all construction workers' toolbox	3.74	0.85	3.84	1.01
12.	Combining a technique from one style of cooking and adapting it to a different cuisine resulting in a dish which receives a Michelin star, one of the highest honors in cooking	3.56	0.99	3.57	0.95
13.	Programming a unique video game	4.08	0.92	3.75	0.85
14.	Combining new spices and ingredients into a BBQ sauce that wins a blue ribbon at the local fair	3.66	0.89	3.13	0.81
15.	Playing sold-out shows with a unique sounding instrument at small clubs	3.57	0.85	3.36	0.96
16.	Creating a new language such as Klingon or Na'vi	4.25	0.98	4.04	0.96
17.	Writing a story that gains national recognition	3.79	0.93	3.71	0.88
18.	Designing a new seasonal trend in fashion	3.36	0.91	3.34	0.86
19.	Selectively breeding corn to create a more weather-resistant variety	3.05	1.04	3.02	0.96
20.	Designing a water bottle that produces less waste and ships more effectively	3.74	0.96	3.63	0.92
21.	Painting a large, highly visible mural	3.44	0.89	3.52	0.97
22.	Creating a product which cleans more efficiently and becomes widely used	3.31	0.87	3.34	0.99
23.	Directing an award-winning independent film	3.61	1.01	3.9	0.87
24.	Selling paintings locally that use a new artistic technique	3.20	0.96	3.17	1.03

	Items	Study 1		Study 2	
		M	*SD*	*M*	*SD*
25.	Using a strategy in a game that does not seem to be effective but is	3.38	0.93	3.11	0.87
26.	Creating an original quilt design	3.92	0.95	3.36	0.89
27.	Testing different instruments and the combination of sounds in a high school band	3.20	0.89	2.83	0.81
28.	Experimenting with natural fabric dyes to color a shirt	3.25	0.81	2.86	0.90
29.	Adapting a technique normally seen in pencil to work with acrylic paint	3.36	0.90	3.08	0.78
30.	Using unexpected ingredients in a stew	2.89	0.71	2.81	0.89
31.	Writing an original short story	3.60	0.92	3.54	0.87
32.	Arranging furniture in an office to promote productivity	2.70	0.89	2.87	0.97
33.	Designing a model of a bridge using only matches and glue	3.08	0.82	2.96	0.92
34.	Mastering an art technique using colored pencils	2.90	1.01	3.02	0.96
35.	Creating a three-dimensional map of a fictional land	3.54	0.92	3.81	0.83
36.	Adapting an established throw in baseball to produce a new pitch in a casual baseball league	2.84	0.78	2.86	1.05
37.	Discovering that moving a pitching hand in a specific manner makes the ball go further while playing catch	3.16	0.80	3.25	0.95
38.	Determining that a chair will fit through a door if turned to another direction	2.62	0.86	2.16	0.96
39.	Hitting a drum hard and soft as a toddler and discovering that the hits produce different sounds	3.00	0.93	2.89	1.02
40.	Testing the effects of water color paints	2.95	0.85	2.48	0.85
41.	Using a cinnamon stick to stir hot cider to see how the flavor of the cider changes	2.36	1.02	2.2	0.78
42.	Expressing the desire to be an astronaut veterinarian when grown up	2.43	1.15	2.45	1.21
43.	Discovering that mixing red and yellow paint produces orange in an elementary art class	2.56	0.87	2.54	0.94
44.	Creating a short poem to help remember the names of the continents	2.82	0.90	2.42	0.89
45.	Using a tool for an effective yet unintended purpose	3.11	0.92	3.27	0.95
46.	Using an unexpected item in a new way	3.19	0.95	3.12	0.96
47.	Perfecting a knife technique that cuts meat more effectively	2.61	0.94	2.76	0.88
48.	Theorizing why Pluto should be considered a planet during a school unit on astronomy	2.69	0.94	2.57	0.94

Table 2

Principal Component Analysis for Study 1 Big-C Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	5.432	45.270	45.270	5.432	45.270	45.270
2	1.233	10.273	55.543	1.233	10.273	55.543
3	.983	8.188	63.732			
4	.803	6.691	70.423			
5	.757	6.308	76.731			
6	.607	5.057	81.787			
7	.604	5.032	86.819			
8	.498	4.148	90.967			
9	.373	3.106	94.073			
10	.293	2.441	96.514			
11	.281	2.340	98.854			
12	.138	1.146	100.000			

Table 3

Principal Axis Factoring with Varimax Rotation for Study 1 Big-C Category

	Factor	
Item	1	2
1	.541	.372
2	.352	.487
3	.444	.393
4	**.882**	.163
5	.411	.491
6	.548	.371
7	.506	.309
8	.253	**.703**
9	**.770**	.249
10	.286	.692
11	.202	**.743**
12	.186	.463

Rotation converged in 3 iterations
Loadings ≥ .7 are bolded

Table 4

Principal Component Analysis for Study 1 Pro-C Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	4.922	41.019	41.019	4.922	41.019	41.019
2	1.371	11.422	52.441	1.371	11.422	52.441
3	1.349	11.246	63.687	1.349	11.246	63.687
4	1.080	9.003	72.690	1.080	9.003	72.690
5	.693	5.775	78.465			
6	.610	5.081	83.546			
7	.543	4.523	88.069			
8	.425	3.538	91.607			
9	.361	3.012	94.619			
10	.269	2.238	96.856			
11	.202	1.685	98.542			
12	.175	1.458	100.000			

Table 5

Principal Axis Factoring with Varimax Rotation for Study 1 Pro-C Category

	Factor			
	1	2	3	4
13	.166	.106	.334	**.792**
14	.194	.163	.069	.683
15	.228	.611	-.005	.398
16	.067	-.007	.589	.459
17	.306	.273	.451	.268
18	.417	.255	.486	.254
19	.596	.172	-.078	.196
20	.593	.183	.186	.125
21	.170	**.763**	.280	.180
22	**.856**	.070	.266	.077
23	.118	.504	**.840**	.023
24	.132	.639	.177	-.012

Rotation converged in 9 iterations
Loadings ≥.7 are bolded

Table 6

Principal Component Analysis for Study 1 Little-c Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	4.727	39.391	39.391	4.727	39.391	39.391
2	1.437	11.979	51.369	1.437	11.979	51.369
3	1.134	9.450	60.819	1.134	9.450	60.819
4	1.001	8.338	69.157	1.001	8.338	69.157
5	.769	6.406	75.563			
6	.650	5.415	80.978			
7	.541	4.506	85.484			
8	.524	4.368	89.852			
9	.412	3.434	93.286			
10	.344	2.870	96.156			
11	.247	2.060	98.216			
12	.214	1.784	100.000			

Table 7

Principal Axis Factoring with Varimax Rotation for Study 1 Little-c Category

	Factor			
	1	2	3	4
25	.183	.069	.125	**.823**
26	**.867**	.071	.132	.260
27	.424	**.751**	.190	.046
28	.462	.621	.111	.115
29	.293	.264	.277	.379
30	.319	.449	.092	.303
31	.638	.108	.307	.116
32	-.118	.517	.494	.258
33	.120	.157	.660	.120
34	.208	.323	.468	.146
35	.399	.135	**.697**	.039
36	-.110	.486	.200	.021

Rotation converged in 15 iterations

Loadings ≥.7 are bolded

Table 8

Principal Component Analysis for Study 1 Mini-c Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	4.839	40.324	40.324	4.839	40.324	40.324
2	1.394	11.618	51.942	1.394	11.618	51.942
3	1.195	9.962	61.903	1.195	9.962	61.903
4	1.062	8.848	70.751	1.062	8.848	70.751
5	.709	5.912	76.664			
6	.603	5.027	81.691			
7	.532	4.431	86.122			
8	.467	3.895	90.016			
9	.384	3.202	93.218			
10	.322	2.686	95.904			
11	.261	2.178	98.083			
12	.230	1.917	100.000			

Table 9

Principal Axis Factoring with Varimax Rotation for Study 1 Mini-c Category

	Factor			
	1	2	3	4
37	.253	.441	.533	-.001
38	.158	.022	**.728**	.139
39	.184	.253	.256	.641
40	.322	.198	-.046	.607
41	.216	.279	.622	.361
42	.043	**.757**	.051	.189
43	.138	.126	.329	.512
44	.491	.016	.052	.271
45	**.785**	.134	.213	.165
46	**.836**	.129	.248	.168
47	.455	.472	.260	.085
48	.103	.640	.189	.373

Rotation converged in 7 iterations
Loadings ≥.7 are bolded

Table 10

Principal Component Analysis for Study 2 Big-C Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	4.826	40.220	40.220	4.826	40.220	40.220
2	1.766	14.713	54.933	1.766	14.713	54.933
3	1.032	8.603	63.536	1.032	8.603	63.536
4	.907	7.562	71.097			
5	.748	6.232	77.330			
6	.687	5.728	83.057			
7	.516	4.303	87.361			
8	.416	3.468	90.829			
9	.399	3.329	94.157			
10	.299	2.493	96.651			
11	.245	2.043	98.694			
12	.157	1.306	100.000			

Table 11

Principal Axis Factoring with Varimax Rotation for Study 2 Big-C Category

	Factor		
	1	2	3
1	**.810**	.160	-.035
2	**.799**	.317	.051
3	.423	.558	.102
4	.158	.528	.400
5	.612	.014	.386
6	-.058	.594	.533
7	.078	.454	.084
8	.691	.157	.242
9	.424	.317	.005
10	.184	**.746**	.065
11	.386	.240	.620
12	.638	.052	.232

Rotation converged in 12 iterations
Loadings ≥.7 are bolded

Table 12

Principal Component Analysis for Study 2 Pro-C Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	3.533	29.444	29.444	3.533	29.444	29.444
2	1.726	14.380	43.824	1.726	14.380	43.824
3	1.201	10.009	53.833	1.201	10.009	53.833
4	1.017	8.478	62.312	1.017	8.478	62.312
5	.838	6.980	69.291			
6	.781	6.512	75.803			
7	.754	6.285	82.088			
8	.673	5.609	87.698			
9	.514	4.281	91.979			
10	.349	2.911	94.890			
11	.342	2.850	97.740			
12	.271	2.260	100.000			

Table 13

Principal Axis Factoring with Varimax Rotation for Study 2 Pro-C Category

	Factor			
	1	2	3	4
13	.135	.115	**.717**	.050
14	**.700**	.086	.113	.134
15	.055	.543	.089	.649
16	-.016	.543	.066	.074
17	**.719**	-.037	.129	.200
18	.295	.400	.084	-.235
19	.622	.192	.271	-.065
20	.536	.158	.022	.019
21	.233	-.067	.123	.376
22	.148	**.785**	-.005	.009
23	.418	-.002	.487	.233
24	.430	.001	.286	.148

Rotation converged in 8 iterations
Loadings ≥.7 are bolded

Table 14

Principal Component Analysis for Study 2 Little-c Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	3.344	27.869	27.869	3.344	27.869	27.869
2	1.625	13.546	41.415	1.625	13.546	41.415
3	1.343	11.195	52.610	1.343	11.195	52.610
4	1.029	8.571	61.181	1.029	8.571	61.181
5	.863	7.188	68.369			
6	.795	6.623	74.992			
7	.720	6.001	80.993			
8	.705	5.873	86.866			
9	.495	4.129	90.995			
10	.460	3.834	94.830			
11	.339	2.828	97.657			
12	.281	2.343	100.000			

Table 15

Principal Axis Factoring with Varimax Rotation for Study 2 Little-C Category

	Factor			
	1	2	3	4
25	.108	.053	.191	**.692**
26	-.008	.220	.419	.199
27	.253	.246	-.030	.195
28	.217	-.012	.475	.065
29	.054	.497	.293	.083
30	.137	**.893**	-.071	.050
31	.677	.221	.199	-.009
32	**.821**	-.008	.034	.143
33	-.055	-.009	**.700**	.073
34	.219	.171	.258	.368
35	.561	.118	.020	.410
36	.159	.443	.472	.176

Rotation converged in 6 iterations

Loadings ≥.7 are bolded

Table 16

Principal Component Analysis for Study 2 Mini-c Category

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Item	Total	% of Variance	Cumulative	Total	% of Variance	Cumulative
1	3.926	32.714	32.714	3.926	32.714	32.714
2	1.394	11.614	44.327	1.394	11.614	44.327
3	1.325	11.045	55.372	1.325	11.045	55.372
4	.958	7.987	63.359			
5	.861	7.175	70.534			
6	.791	6.589	77.123			
7	.665	5.540	82.663			
8	.614	5.114	87.776			
9	.466	3.881	91.658			
10	.373	3.110	94.767			
11	.353	2.940	97.707			
12	.275	2.293	100.000			

Table 17

Principal Axis Factoring with Varimax Rotation for Study 2 Mini-c Category

	Factor		
	1	2	3
1	.190	**.735**	.132
2	.146	.173	.578
3	.282	.117	.666
4	.028	.005	.367
5	**.747**	-.035	.218
6	.091	**.782**	.183
7	.395	.112	.160
8	.274	.344	.420
9	.156	.257	.557
10	.101	.379	.091
11	.676	.393	-.007
12	.585	.238	.225

Rotation converged in 5 iterations
Loadings ≥.7 are bolded

Figures

Figure 1
Scree plot Study 1 Big-C Category

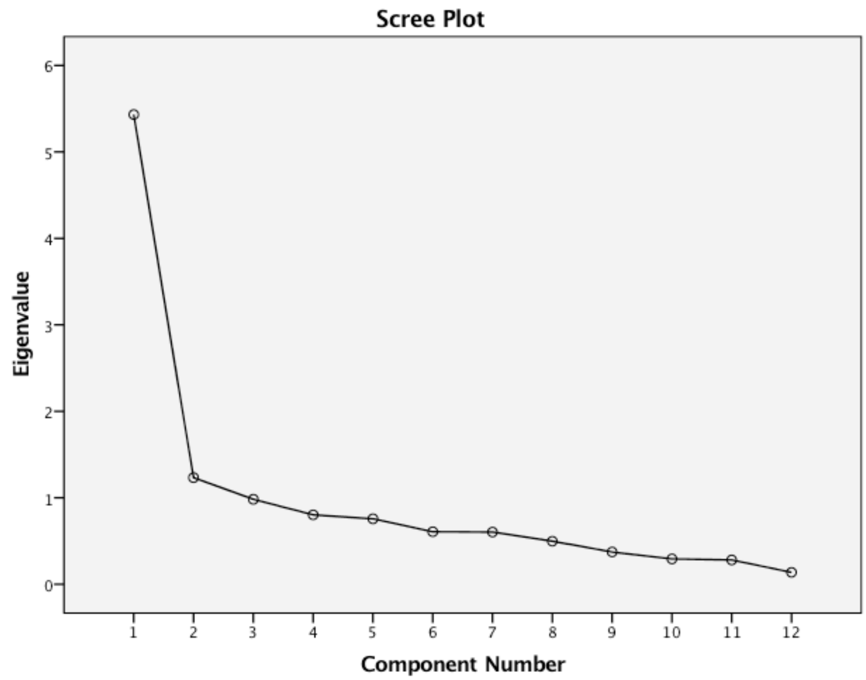

Figure 2
Scree plot Study 1 Pro-C Category

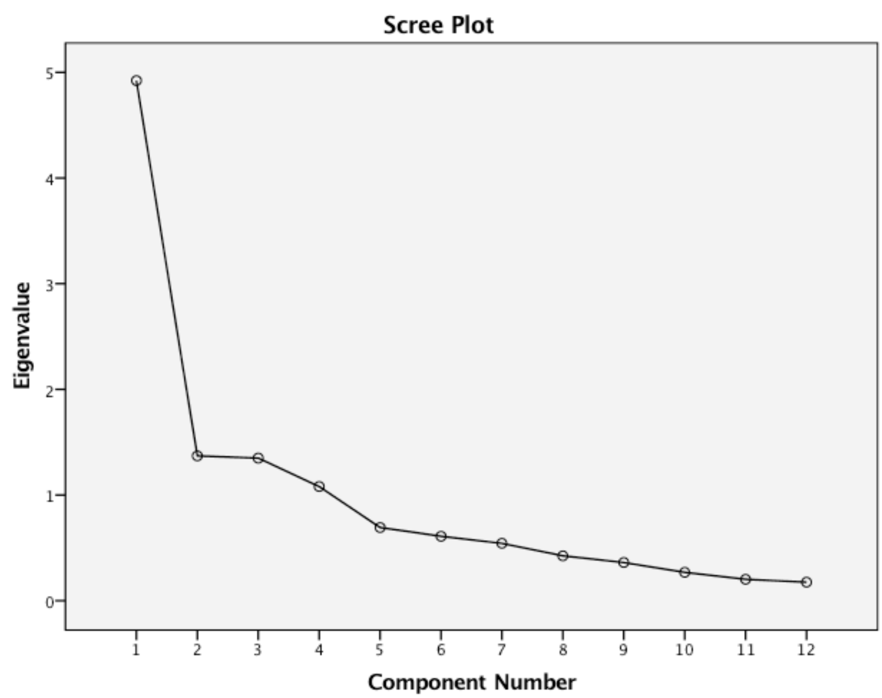

Figure 3
Scree plot Study 1 Little-c Category

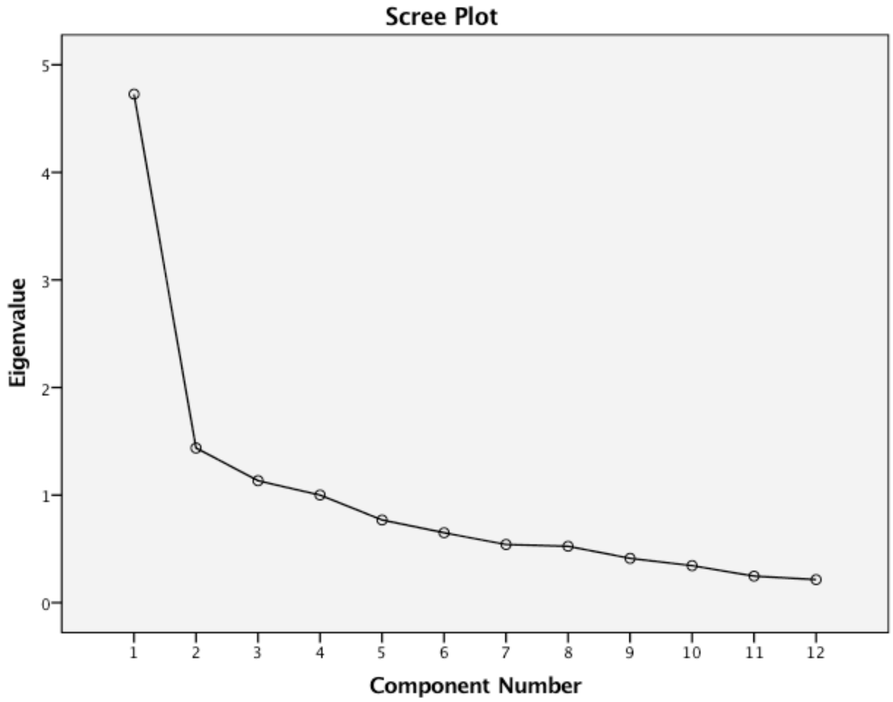

Figure 4
Scree plot Study 1 Mini-c Category

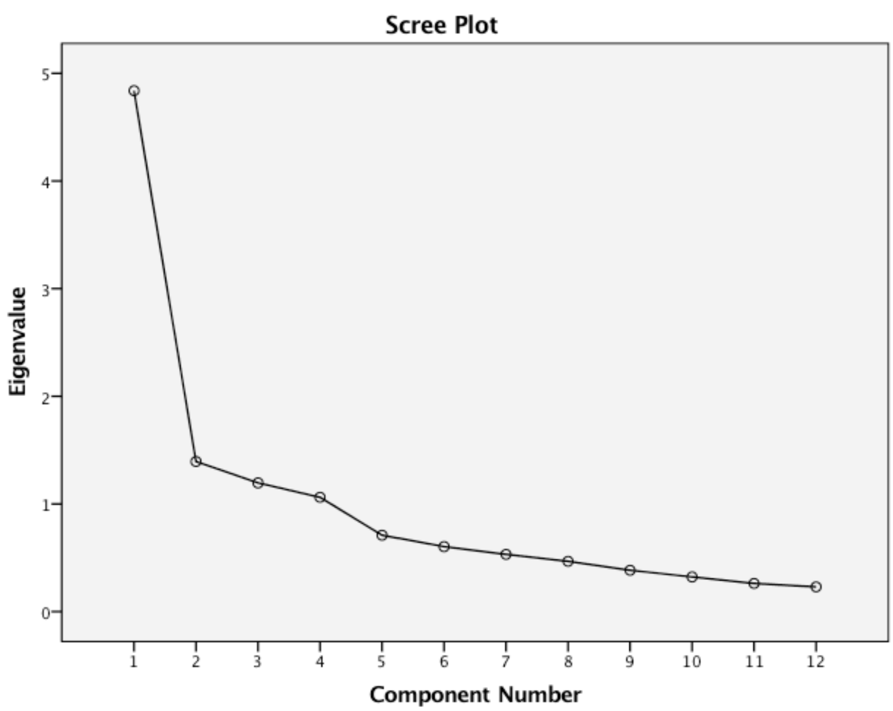

Figure 5
Scree plot Study 2 Big-C Category

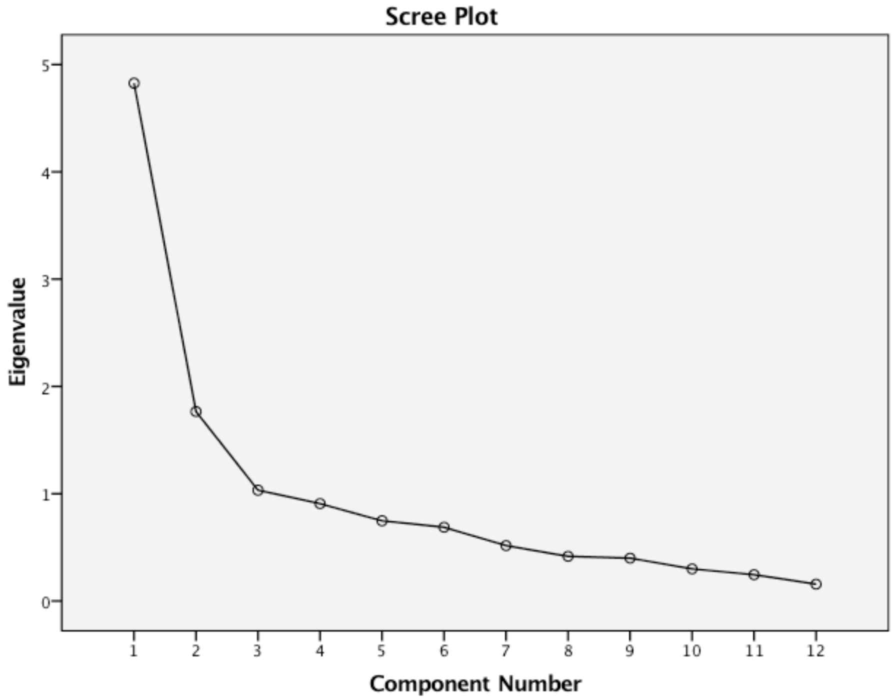

Figure 6
Scree plot Study 2 Pro-C Category

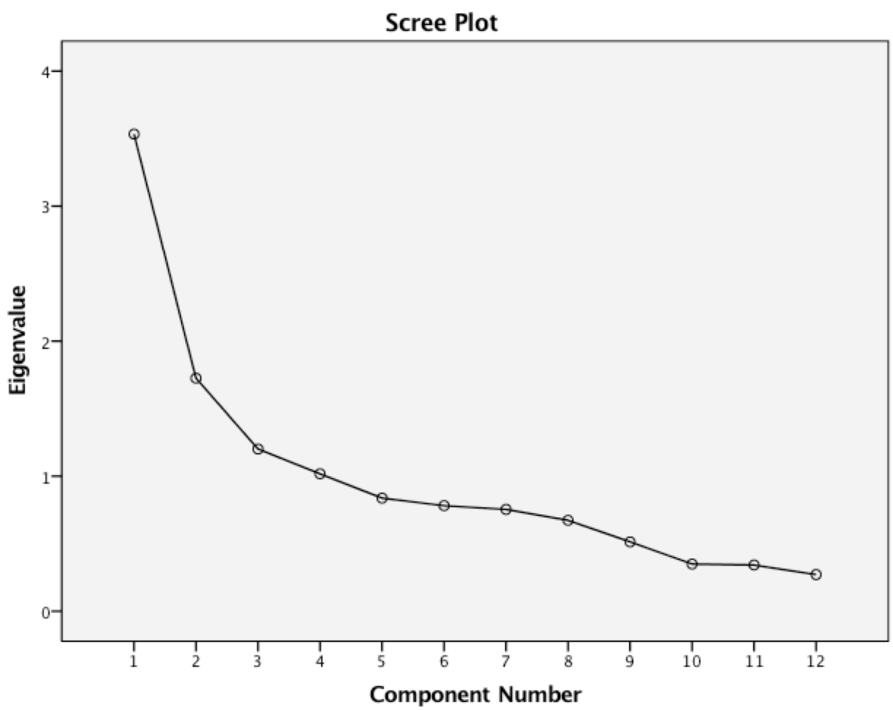

Figure 7
Scree plot Study 2 Little-c Category

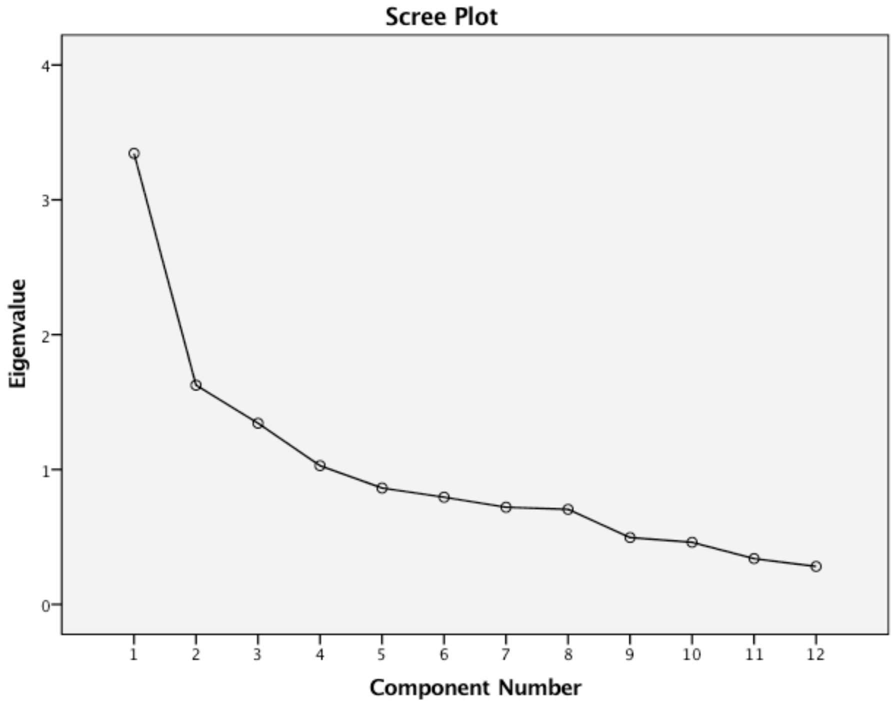

Figure 8
Scree plot Study 2 Mini-c Category