What Makes a Topic Interesting? A Conceptual and Methodological Exploration of the Underlying Dimensions of Topic Interest

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Abstract

Interest has long been recognized as an important motivator of learning. Recent research, however, has reported a trend of declining interest in science among young students, which suggested that school science has not been effectively fostering student interest. In order to help students develop an enduring interest in the topics taught at school, the first, and perhaps the fundamental step is to understand what it is about a topic that makes it interesting (or uninteresting). As a preliminary effort to address this question, a mixed-method study combining quantitative data from paired-comparison preference judgments and qualitative data from semi-structured interviews was undertaken with the goal of determining the underlying topic attributes that influence middle school students' perceived interestingness of school-related topics. The results suggest a set of possible attribute dimensions – a topic's activeness, importance, familiarity, coolness, and challengingness. Implications of the findings in the context of related research and future research directions are discussed.

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Introduction

The Importance of Interest in Science Education

Commonly conceptualized as a relatively stable motivational orientation or personal predisposition that develops over time towards a particular stimulus or domain (Renninger, Hidi & Krapp, 1992), interest has long been recognized as playing a significant role in education. In *Interest and Effort in Education* (1913), Dewey argued that interest is the ultimate driving force behind self-initiated learning behaviors. According to Dewey, when a person is genuinely interested in something, he or she will automatically be motivated to engage in activities that allow him or her to learn more about it. That is, if people are interested in what they are learning, then the issue of lack of motivation that so many educators and researchers are battling against may be solved.

Given the intimate relationship between interest and motivation (Hidi & Harackiewicz, 2000), it is not surprising that the positive impact of interest on learning has been documented in a wide range of learning situations. Positive correlations have been observed between interest and a variety of standard learning outcomes such as test scores, grades, and GPAs (Krapp, Hidi & Renninger, 1992). A meta-analysis (Schiefele, Krapp & Winteler, 1992) showed that interest on average accounts for about 10% of the observed achievement variance across subject areas, types of schools, and age groups. Particularly relevant in this study is the finding that the average interest-achievement correlation for natural science subject areas is among the highest ($r = 0.34$) – a quite large effect considering the complicated nature of education. Furthermore, interest has also been shown to positively impact learners' cognitive skill development, such as facilitating deep (as opposed to superficial) information representation (Schiefele, 1996) and promoting the use of metacognitive strategies (Pintrich, Marx, & Boyle, 1993), both of which are learning outcomes desired in science education.

Recognizing the important role interest plays in promoting learning, educators would be encouraged if students showed interest in the materials taught at school. However, students' academic interest seems to be declining over time (Anderman & Maehr, 1994). This trend is particularly obvious among secondary-school students, and with respect to subject domains such as science (Eccles & Wigfield, 1992, Martin, Mullis, Gonzalez, & Chrostowski 2004; Schmidt et al., 2001; Yager & Yager, 1985). Faced with this reality, researchers have suggested that one way to improve student interest is to provide materials that cater to students' interest, which students presumably are more likely to be motivated to learn (Edelson & Joseph, 2004; Garner, Brown, Sanders, & Menke, 1992; Wade, 2001). However, in order to do so, we need to first develop a firm understanding of what students are interested in.

Previous Research on Understanding Interest-influencing Factors

One approach to understand student interest is to identify the science topics that students consider interesting. For instance, Dawson (2000) asked seventh-grade students in Australia to indicate the interestingness of 77 science topics (e.g. 'earthquakes') representing a broad range of scientific domains, and identified a set of topics that are most popular for these students. A similar approach was also taken with a group of 14- and 15-year-old students in England as part of a large-scale study on student attitudes toward science (Jenkins & Nelson, 2005). Baram-Tsabari and Yarden (2005) examined the (primarily science) questions Israeli children sent to a popular children's TV show that provides answers to these questions (e.g. 'if you go on a diet, where does the fat go?'), and found that topics of biology, technology and astrophysics were of high interest to the nine to twelve year-old children.

A considerable amount of work has also been done in examining the interest-influencing properties of two types of object of interest – perceptual stimuli and text. Berlyne (1960, 1971) is perhaps the most prominent researcher who studied the relationship between characteristics of simple perceptual stimuli and their perceived interestingness. Using simple visual (e.g. polygons) or auditory (e.g. tones) stimuli, Berlyne and colleagues (Day, Berlyne, & Hunt, 1971) varied selected aspects of the stimuli (e.g. the number of sides of a polygon) and examined how such variation affected people's interestingness judgments. The findings from these studies led Berlyne to propose a set of stimuli characteristics – which he called *collative_variables* – that contributed to the perceived interestingness of such stimuli: novelty, complexity, unexpectedness, ambiguity and variability.

In the field of text comprehension, consistent with Berlyne's views concerning collative variables, texts with unexpected, suspenseful or conflicting content tend to elicit more interest than texts lacking such features (Hidi & Baird, 1986; Hidi, 2001; Iran-Nejad, 1987). Other features of texts have also been shown to influence interestingness judgments. For example, texts that include characters or life-themes that an individual can identify with (Hidi, 1990, 2001; Krapp, Hidi & Renninger, 1992), and texts that deal with personally relevant issues (Garner, et al., 1992; Schraw, Flowerday & Lehman, 2001; Wade, 1992) are more likely to be deemed interesting. In addition, other content-bound text characteristics such as text coherence (Schraw, Bruning & Svoboda, 1995; Schraw & Lehman, 2001), intensity (Hidi, 1990, 2001), vividness (Schraw, Bruning & Svoboda, 1995), and activity level (Garner et al., 1992; Wade, 1992) have all been shown to be sources of interest in texts.

There is no doubt that these research findings provide valuable information. For example, knowing what topics are of high interest to students can help teachers in choosing (when possible) what topics to teach, and what we know about interest in text can help textbook writers and publishers create reading materials that are more attractive to students. However, it is unlikely that we could build a science curriculum solely based on the topics in which students expressed interest, or make a boring topic interesting simply by teaching it via exciting texts. That is, the information gathered in previous research is far from sufficient to guide our practice in enhancing student interest.

Purpose of Study

In this paper, I propose an alternative way of understanding student interest that combines the foci of the above-mentioned studies. That is, I am exploring what *about* the objects of interest – in this case, the various content topics students are required to learn at school – makes them interesting (or uninteresting). Specifically, I propose the approach of examining the topics students currently encounter at school, identifying those that are deemed interesting (or uninteresting), and investigating the attributes that make them more interesting (or uninteresting) to the students than others. For the purpose of this paper, I focus primarily on science topics.

Methods

Study Design Considerations

In contrast to previous research that manipulated stimulus properties to examine how they affect 'on-the-spot' judgments of interestingness, this study examined what characteristics are associated with students' enduring interest of school-type topics – often referred to as *topic interest* (Schiefele, 1996) – by engaging students in a simple task of judging which one of a pair of topics is more interesting. This task of *paired-comparison preference judgment* was chosen in this study mainly because of its potential, when coupled with the *multidimensional scaling (MDS)* analysis technique (Kruskal & Wish, 1978), to discover the 'hidden structures' of data that are otherwise difficult to capture (Carroll & Arabie, 1980) – in this case the underlying dimensions of topic interest. That is, instead of asking young students to describe the characteristics of a topic that makes it interesting (or uninteresting), which is a very difficult task, I tried to extract such information from their responses to a series of simple preference judgments.

Follow-up interviews with individual students were also conducted as an alternative means of data collection, with the goal of verifying and further exploring the findings that emerged from the paired-comparison preference judgment data.

Participants

Participants were 16 students in a sixth-grade science classroom of a suburban middle school near a major Midwest city in the USA. The participants consisted of an equal number of boys and girls; their diverse ethnic background (5 Caucasian, 9 African-American, 1 Asian, and 1 Hispanic) reflected the school and the district they belong to. Participants also varied in terms of academic performance level (5 high, 7 medium, and 4 low) and perceived science interest level (7 high, 5 medium, and 4 low), both of which were subjectively judged by their teacher by comparing them with fellow students of the same class.

Materials and Procedures

Data were collected using two questionnaires and a series of interviews over a period of 4 weeks. Two questionnaires were administered at an interval of 3 weeks, with the second questionnaire designed to confirm and elucidate the results of the first. All participants completed both questionnaires. The interviews were conducted one week after the administration of Questionnaire 2. Half of the participants (eight students) were interviewed.

Questionnaires. Questionnaire 1 (Appendix 1) was aimed at soliciting from participants their interest-based topic preferences. Sixteen topics (Table I) were included in the paired-comparison preference judgment task. In order to facilitate the discovery of any possible underlying dimensions of topic interest, I selected a wide variety of topics -- fourteen science topics from different science content areas, three math topics and two extracurricular topics. I limited the selection to 16 topics to ensure that students had sufficient time to complete the task within the allocated time (one 40-minute class period).

Table I
Topics Used for Interestingness Judgment

Topic	Code	Content Area(s) Represented
How cells work	HC	Science - Biology
How animals survive in the wild	HA	Science - Biology
Sexual reproduction in animals	SR	Science - Biology
How pollution harms the environment	HP	Science - Environmental
Forces and gravity	FG	Science - Physics

Stars and planets	SP	Science - Astronomy
Earthquakes and volcanoes	EV	Science - Geography
How our bodies turn food into energy	OB	Physical Education & Health / Science - Biology
Why junk food is bad for us	JF	Physical Education & Health
The US government	US	Science - Social
Different cultures and countries	DC	Science - Social
Math puzzles	MP	Mathematics
Charts and graphs	CG	Mathematics
Fractions and proportions	FP	Mathematics
Basketball	BB	Extracurricular
Video games	VG	Extracurricular

In Questionnaire 1, participants received a booklet including all possible (120) pairs of the 16 topics. For each pair, participants were asked to answer the question: 'If you had to listen to someone talking about the topics A and B (*referring to the two topics in the pair),* which do you think you'd find more interesting?' Participants were asked to indicate their answer for each pair by using a highlighter (provided with the booklet) to mark the one they found more interesting. In addition, as a validity check for the pair-wise comparison data, a separate set of questions asking participants to rate how interesting they found each topic on a 4-point Likert scale was included on the last page of the booklet.

It should be pointed out that the typical pair-wise comparison tasks used with the MDS analysis technique (Kruskal & Wish, 1978) ask participants to judge the similarity (or dissimilarity) between two objects (e.g. How similar are car A and car B). However, considering the developmental stage of the participants and their limited availability to complete the questionnaire (one class period), I chose to use the simpler task of judging 'which of the two is more interesting' (as opposed to 'how similar topic A and B are in terms of their interestingness') to ensure that the task is not too difficult or time-consuming for the participants. In comparison to the typical judgment tasks, this simpler version does not quantitatively capture the actual perceptual distances (in terms of interestingness) between the topics. However, for the purpose of this study, only a qualitative characterization of such distances is needed, which can be easily derived from the data collected through the simpler judgment task. Therefore, the choice of the simpler judgment task is more appropriate for the participants, and at the same time, provides sufficient information to accomplish the goal of this study.

Questionnaire 2 (Appendix 2) was designed based on the data derived from Questionnaire 1 (see the 'Results and Discussion' section for details). Specifically, participants were asked to rate each of the 16 topics on the following attribute dimensions on a 5-point Likert scale: *active, cool, mysterious, important, familiar,* and *typical of school* (e.g. 1 = not active at all, 5 = very active). These attributes were reviewed and approved by the science teacher for their intelligibility for the participants, and a brief description of the attributes was provided to ensure that participants understood their meaning.

Follow-up Interviews. Semi-structured interviews (Miller & Crabtree, 1999) were conducted after the administration of the second questionnaire to gain further understanding of why the participants found some topics interesting but not others. Eight out of 16 participants were chosen for interviews. The interviewees were first randomly selected, and then minor adjustments were made to meet two criteria: 1) Their demographic and academic characteristics were approximately the same as the entire participant group; 2) They were recommended by their science teacher for their 'consistently good and respectful behavior', an attempt to ensure the success of the interviews and the quality of the interview data.

To avoid restricting interviewees' answers to the attribute dimensions identified from the paired-comparison preference judgment data (i.e. the dimensions included in Questionnaire 2), no reference to these dimensions or Questionnaire 2 was made. Instead, interviewees were presented with the top five most and least interesting topics he or she had reported in Questionnaire 1, and asked to explain what it was about these topics that led to such judgments. Each student was interviewed individually for 10-15 minutes during regular class periods. All interviews were tape recorded and transcribed verbatim.

Results and Discussion

Perceived Topic Interestingness

Participants' ratings of how interesting each topic is (in Questionnaire 1) were averaged to see how topics vary in terms of their perceived interestingness. The results showed that across participants the extracurricular topics ('video games', 'basketball') were rated as the most interesting ones, while the math topics ('charts and graphs', 'fractions and proportions', 'math puzzles') were rated as least interesting. Most of the science topics received middling values, with the exception of 'stars and planets' (highly interesting), 'sexual reproduction in animals' (uninteresting), and 'why junk food is bad for us' (uninteresting).

Multidimensional Scaling (MDS) Analysis

Multidimensional Scaling (MDS) was used in this study to analyze the paired-comparison judgment data. Originated in psychometrics, MDS has been used in various fields to help researchers understand people's judgments of the relationship between members of a set of stimuli (Young, 1985). In essence, MDS constructs a spatial representation of stimuli in which the distance between any two stimuli corresponds to the perceived proximity of the stimuli. By doing so, MDS summarizes a large number of relations among stimuli in a perceptual space that can be easily visualized, which often makes it much easier to comprehend the data (Kruskal & Wish, 1978). This unique feature of MDS lends it the power to reveal the underlying structure of data, and thus makes it an appropriate analysis tool for this study.

Configuration of Topic Interest. The particular MDS model used in this study was Tucker's *Vector Preference Model* (Tucker & Messick, 1963), because this model was better suited to analyze the type of simple preferential choice data available in the study. In this model, each individual's pair-wise comparison data are compiled to form a matrix representing the topic preferences (in terms of topic interestingness) of the particular individual. The rows and columns of this matrix are the 16 topics, and the value in each cell represents the individual's preference choice between the row topic and the column topic. The values were coded as 1s and 0s, where 1 means that the column topic is preferred over the row topic and 0 otherwise. The sum of each column was calculated to give a 'ranking' of the corresponding topic, with the sum showing how many times this particular topic was preferred over the other topics. The 'topic rankings' of all participants were then combined to form a new matrix, with the rows representing the participants and the columns the topics. Each row shows the particular participant's 'preference rankings' of the topics.

This new matrix was then used as input in the non-metric MDS program available in SPSS – the ALSCAL program (Young, 1985). The values in the matrix were treated as ordinal data, and Euclidian distances between the topics were generated by the program to obtain a configuration of the topics in a space of interestingness. As the rough 'rule of thumb' states that the number of stimuli (in this case, 16) minus one should be at least four times as great as the configuration dimensionality (Kruskal and Wish, 1978), MDS solutions with more than three dimensions were considered inappropriate for this data set. Therefore, solutions with 1-3 dimensions were generated (Table II). Comparison of the goodness-of-fit for these solutions showed that the increase of dimensionality reduced S-Stress ('badness-of-fit' indicator) substantially, and correspondingly increased R-square values. Therefore, the 3D solution (the best-fitting solution) was chosen as the most appropriate representation of data. The details of the 3D configuration are shown in Table III and Figure 1.

Table II
Summary of Multidimensional Scaling (MDS) Solutions with 1-3 Dimensions

Solution Dimensionality	Young's S-Stress ('Badness-of-fit' indicator)	Percent of S-Stress reduction by adding 1 dimension	R-square ('Goodness-of-fit' indicator)	Percent of R-square increase by adding 1 dimension
1D	0.23	---	0.85	---
2D	0.14	39.1	0.91	7.1
3D	0.07	50.0	0.96	5.5

Table III
Coordinates Representing the Location of the Topics in the 3D MDS Configuration

Topic Code	Coordinates		
	Dimension 1	Dimension 2	Dimension 3
HC	0.32	1.00	-0.86
HA	-1.06	-0.56	0.39
FG	-0.44	0.88	-0.67
EV	-0.86	0.26	0.43
SR	1.77	-0.44	-1.22
US	1.01	1.49	0.22
HP	-0.02	0.89	0.17
FP	1.93	-0.18	0.87
OB	0.20	0.69	-0.61
JF	1.34	-0.78	-0.31
DC	-0.65	0.54	1.29
MP	1.17	-1.15	0.53
CG	1.43	-0.73	0.39
VG	-2.47	-0.79	-1.01
BB	-2.32	-1.47	0.11
SP	-1.33	0.34	0.28

Because the dimensions produced by the computer programs may not be meaningful or not susceptible to direct interpretation (Kruskal & Wish, 1978), MDS configurations require subjective interpretations. In order to uncover the dimensions that could explain the positioning of the stimuli (in this case, the topics) in the configuration, the 3D MDS configuration was first visually examined to 'look for lines in the space…such that the stimuli projecting at opposite extremes of a line differ from each other in some easily describable way' (Kruskal & Wish, 1978, p.31). Six such lines that appeared to represent various topic *attribute dimensions*[1] were detected – *active* (dynamic, fast-changing in nature), *cool* (popular or fashionable), *important* (bearing personal significance), *mysterious* (puzzling; very little is known), *familiar* (commonplace or usual), and *typical of school* (associated with school).

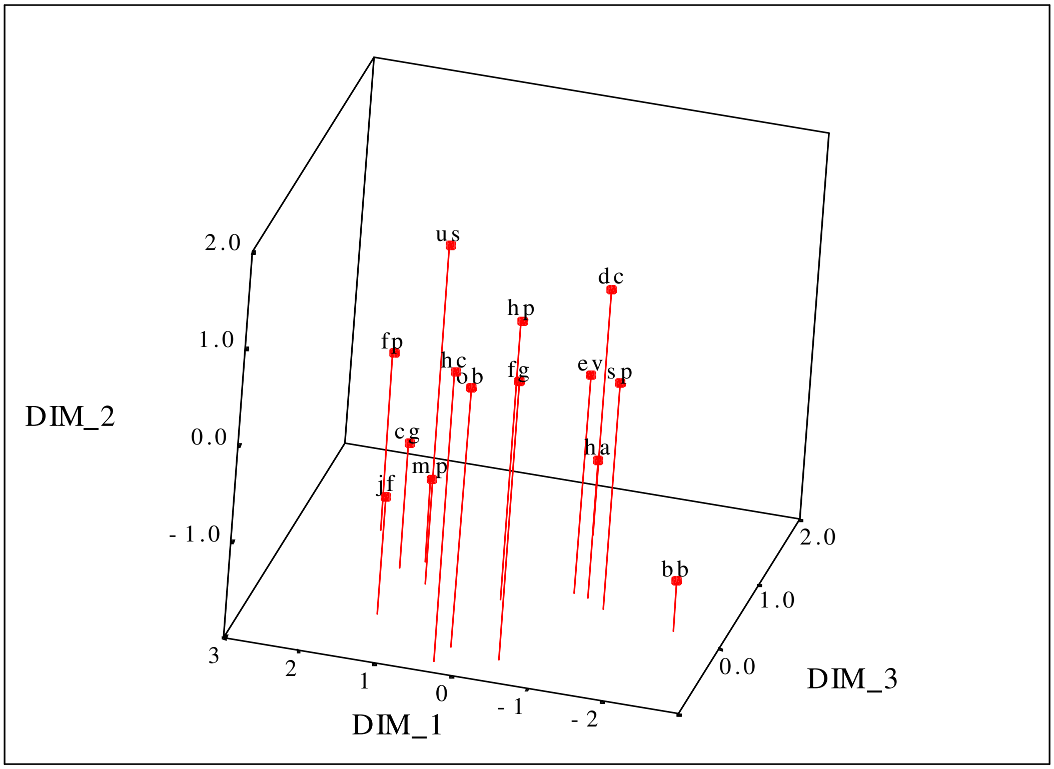

Figure 1. 3D MDS Configuration of Topic Interestingness based on Paired-Comparison Preference Judgment Data

To test these interpretations, Questionnaire 2 was administered to obtain participants' perception of the topics on these attribute dimensions. For each attribute dimension, individual participants' ratings were averaged to obtain a score for every topic (Table IV). The correlations of the average scores on these attribute dimensions (Table V) showed that the *active* and *cool* attribute dimensions are highly correlated (r = 0.946), suggesting that participants may have the tendency of viewing active things as cool, which possibly could be explained by the participants' age and developmental stage.

Table IV
Average Participants' Ratings on Speculated Attributed Dimensions on 5-point Likert Scale

Topic Code	Attribute Dimensions					
	Active	Cool	Important	Mysterious	Familiar	Typical of School
HC	3.31	3.19	4.56	2.69	2.75	4.50
HA	3.06	3.25	4.06	2.88	3.19	3.88
FG	3.93	3.47	4.31	3.00	3.13	4.50
EV	3.75	3.19	4.13	2.69	3.87	4.56
SR	2.75	2.75	3.19	2.81	2.63	3.44
US	2.94	2.56	4.00	2.50	3.33	4.69
HP	3.00	2.75	3.81	2.56	3.25	3.31
FP	2.50	2.44	3.63	2.56	3.81	4.63
OB	3.38	2.81	3.50	3.06	3.06	3.69
JF	2.50	2.13	3.31	2.81	3.13	3.40
DC	3.94	3.69	4.06	2.94	3.87	4.44
MP	2.88	2.44	3.00	2.44	3.56	4.63
CG	2.53	2.56	3.19	2.50	3.50	4.25
VG	4.44	4.50	2.88	2.19	4.63	1.88
BB	4.75	4.69	3.13	2.19	4.44	2.88
SP	4.13	4.31	4.44	3.88	4.50	4.44

Table V
Correlations of Average Participants' Ratings of Topics on Speculated Attribute Dimensions

	Active	Cool	Important	Mysterious	Familiar	Typical of School
Active	---	---	---	---	---	---
Cool	0.946*	---	---	---	---	---
Important	0.130	0.100	---	---	---	---
Mysterious	0.063	0.087	0.596*	---	---	---
Familiar	0.657*	0.701*	-0.182	-0.074	---	---
Typical of School	-0.349	-0.416	0.603*	0.384	-0.275	---

* $p<0.05$

If, as I speculated, these attribute dimensions have a systematic relationship to the positioning of the topics in the configuration, then the configuration (i.e., the location of the topics in the 3D space) should be able to explain these average ratings on the attribute dimensions (i.e. the loadings of the topics on the attribute dimensions). To test this, a multiple regression was performed using the average rating on each of the attribute dimensions as the dependent variable and the coordinates for the 3D configuration as the independent variables. This procedure was not conducted with the attribute dimension *typical of school* because it did not follow a normal distribution as revealed by a Q-Q plot normality check. For the rest of the attribute dimensions, the regression analysis (Table VI) revealed a significant relationship for all attribute dimensions except for *mysterious*. Therefore, only the attribute dimensions *active, cool, important,* and *familiar* were confirmed as having systematic relationships with the coordinates. These results suggest that topic interest is influenced by, though not limited to, how active, cool, important, and familiar the topics are perceived to be (Figure 2).

Table VI
Multiple Regression of Average Attribute Dimension Rating on the Coordinates for the 3D MDS Configuration of Topic Interestingness

Attribute Dimension (Dependent Variable)	Regression Coefficients						Multiple R	R-square
	Dimension 1 Coordinates		Dimension 2 Coordinates		Dimension 3 Coordinates			
	B (SE)	β	B (SE)	β	B (SE)	β		
Active	-0.472* (0.059)	-0.919	0.053 (0.094)	0.065	-0.057 (0.115)	-0.056	0.919*	0.844
Cool	-0.508* (0.065)	-0.905	-0.045 (0.104)	-0.051	-0.062 (0.128)	-0.056	0.916*	0.839
Important	-0.086 (0.067)	-0.219	0.486* (0.107)	0.783	0.153 (0.131)	0.199	0.806*	0.650
Familiar	-0.278* (0.075)	-0.640	-0.183 (0.119)	-0.266	0.326* (0.147)	0.381	0.805*	0.647
Mysterious	-0.019 (0.077)	-0.067	0.178 (0.122)	0.389	0.031 (0.151)	0.055	0.389	0.152

* $p < 0.05$

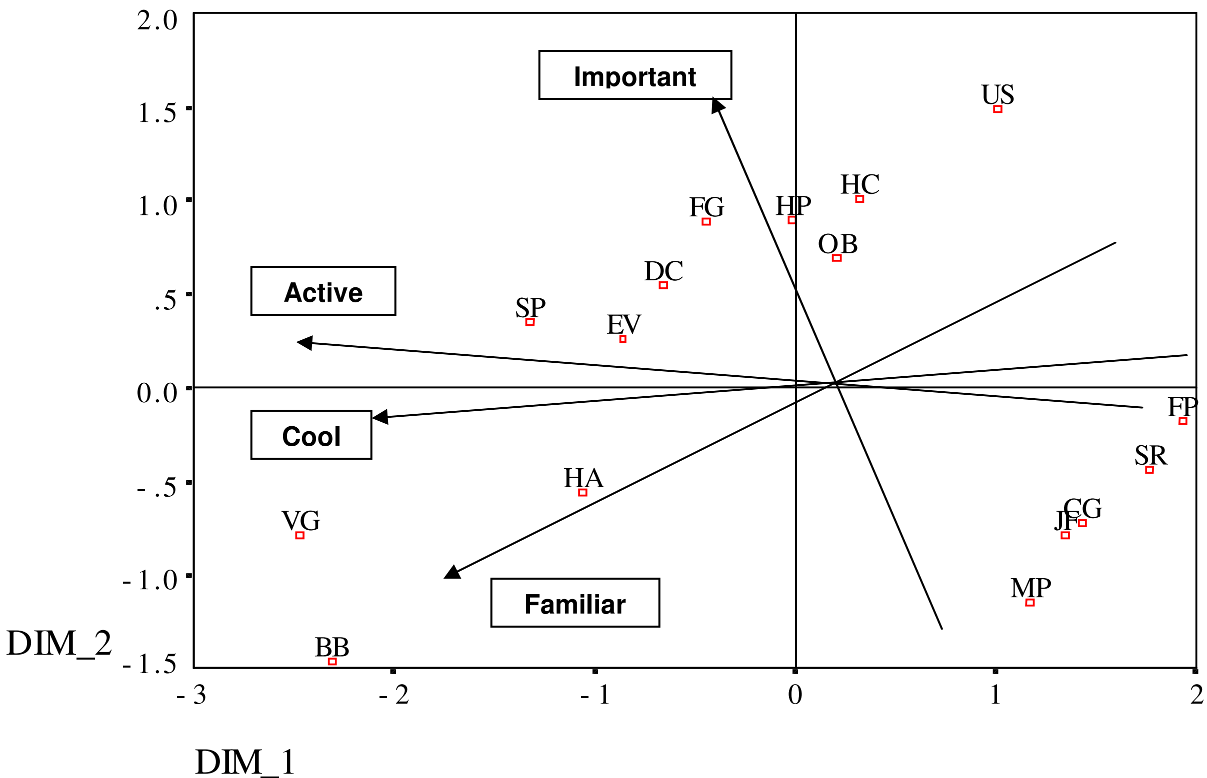

Figure 2. 3D MDS Configuration of Topic Interestingness with Topic Attribute Dimension (showing the plane of Dimension 1 and 2)

While it is quite likely that these attribute dimensions do not have a linear relationship with topic interestingness, a hierarchical linear regression was performed using the participants' ratings of topic interestingness as dependent variable and their ratings of topics on the *active, cool, important,* and *familiar* attribute dimensions as independent variables to gain a general sense of the relative strength of these four attribute dimensions (Table VII). The results showed that, while all of these four attribute dimensions influence participants' topic interest, *active* and *cool* seem to be the particularly strong ones.

Table VII
Hierarchical Regression of Topic Interestingness Ratings on Ratings of Topics on Attribute Dimensions

	Attribute Dimensions (Independent Variables)	Regression Coefficients B (SE)	β	R-square	R-Square Change
Step 1	Important	0.186 (0.047)	0.244*	0.059	0.059*
Step 2	Important	0.104 (0.046)	0.137*	0.185	0.125*
	Familiar	0.271 (0.044)	0.370*		
Step 3	Important	6.361E-03 (0.040)	0.008	0.428	0.243*
	Familiar	0.154 (0.039)	0.210*		
	Active	0.406 (0.040)	0.545*		
Step 4	Important	-1.820E-02 (0.038)	-0.024	0.496	0.068*
	Familiar	7.070E-02 (0.039)	0.096		
	Active	0.238 (0.048)	0.320*		
	Cool	0.275 (0.048)	0.398*		

*p<0.05

Interview Data Analysis

One of the reasons for using a procedure such as paired-comparison preference judgments in an attempt to discover some of the determinants of topic interest was the belief that people (especially children and adolescents) might not have these determinants available for introspection, and/or would have difficulty articulating them. This belief was supported by the work of Nisbett and Wilson (1977), which raised serious concerns of people's ability to accurately introspect and report on their cognitive processes. It was further confirmed by my observation that, for the interviewees, verbalizing reasons why they found something interesting (or uninteresting) seemed to be quite difficult. Most interviewees, for one or more topics, could not give explicit reasons for finding them interesting or boring, even when they expressed strong opinions about the topics' interestingness. For example, when asked about the topic 'charts and graphs', Kevin[2] stated his opinion definitively and quickly: 'Oh, I don't like those at all'! But when I asked him to explain his opinion, he said: 'Just don't like looking at boring stuff'. When further probed, his only response was: 'Yeah, but they're just lines and shapes. Doesn't seem fun to me'. Kevin was not alone in this regard; similar responses such as 'I don't know', 'They're just fun to play', or simply long periods of silence were common among the interviewees. Clearly much of the participants' knowledge about their own interest development was tacit, which made it difficult for them to explain why they found some things interesting and others not.

Coding Process. The coding process of the interview transcripts loosely followed the procedures recommended by Emerson, Fretz and Shaw (1995). The interview transcripts were first informally reviewed to get a general sense of any themes they might contain. Individual interview transcripts were then coded line-by-line to identify all the factors that interviewees claimed to influence their judgments of how interesting (or uninteresting) a topic was. Codes emerging from individual transcripts were compared, and codes that represented similar factors were combined. The resulting codes were applied to all transcripts, and definitions of codes were further specified to enhance their fit to the data. The final list of codes is listed in Table VIII. The coding results were summarized, analyzed, and compared with the findings from the MDS analysis.

Table VIII
Codes used to analyze interview data

Code Domain	Code	Definition	Number of interviewees who mentioned this factor
Familiar	Familiar	Things personally experienced in either learning or informal situations	4
	Novel	Things that differ from daily practice or appear novel	4
	Overexposure	Things that have been encountered too often	2
Important	Important	Things that affect human lives in general, affect own lives or future, or are otherwise deemed important	6
Active	Active	Things that have a fast-moving or constantly changing nature	5
Challenging	Challenging	Things that are 'not too easy' and pose intellectual or physical challenge	4
	Too hard	Things that are deemed too difficult	2
Cool	Cool	Things that are deemed popular among friends or peers	2
Non-school	Non-school	Things that are not typically associated with school	2

Mysterious	Mysterious	Things that little is known of, cannot be controlled, or present uncertainties in how they happen	2
Top-down	Top-down	Things whose interest is inherited from a superordinate category	4
Teaching method	Teaching method	Things whose interest depends on the way they are taught	4

Major Topic Attribute Dimensions. With the exception of coolness, all of the topic attribute dimensions confirmed in the MDS analysis emerged as major factors that influence topic interest. In addition, interviewees also suggested a new attribute dimension – the challengingness of a topic.

Judging by the frequency of occurrence[3] (n=12), the most salient factor that influenced participants' topic interest was pertinent to their *familiarity* with the topic. Topics that participants had personal connection to or experience with seemed to be deemed interesting. For instance, Lauren expressed high interest in the topic 'earthquakes and volcanoes' because her mother almost lost her life in an earthquake. Similarly, Paul rated 'stars and planets' as interesting because he had done a project on this topic in a science fair. The finding of a familiarity dimension is consistent with the results identified in the MDS analysis; but beyond that, the interview data suggest that an important determinant of familiarity may be personal connection or involvement, rather than merely exposure in everyday life.

While familiar topics were deemed interesting by several interviewees, the interview data also revealed that the relationship between topic *familiarity* and topic interest is not linear. A couple of interviewees suggested that *novel* topics – those that differ from their daily lives – seemed to be interesting as well. Both Sam and Kelly found 'different cultures and countries' interesting because they found it interesting to see the difference between their own and other cultures. Paul found basketball interesting partly because 'at my old school, we didn't play basketball that much'. On the other hand, topics that participants were too familiar with or to which they were *overexposed* were considered boring. This pattern was particularly obvious for the topic 'why junk food is bad for us': 'Because that's all they talk about. Like in gym, we had to watch movies about why junk food is bad for us, and I KNOW junk food is bad for us, I don't want to learn about that any more… At this age, they don't need to drive it into us as much' (Interview-Paul).

Consistent with the MDS analysis results, interviewees also reported topic *importance* as a factor that influences topic interest. However, the interview data suggested that topic importance was interpreted in at least two different ways by the participants: 1) Topics pertaining to things that affect human lives in general were deemed important – Sam claimed to be interested in 'how pollution harms the environment' because 'it (the pollution) kills things…it smells bad…it makes our world really nasty' and he wanted to 'know more about it…help prevent it'; 2) Topics pertaining to things that affect participants' own lives were deemed important. For example, several interviewees expressed the belief that math topics had no use in their lives or future: 'Oh man! Those (fractions and proportions) are so boring…You're sitting there in a hot room, writing, doing tons of worksheets, wondering how it's going to help you in the future' (Interview-Adam).

Similar to the *active* attribute dimension identified in the MDS analysis, topics that have to do with things of a dynamic or fast-changing nature seemed to be considered interesting. For example, 'video games' were considered interesting partly because of its 'constant action' (Interview-Adam), and 'basketball' was found interesting because it was 'more active, more fun to do…You run around instead of sitting at a place studying' (Interview-Kelly). Interestingly, two students expressed opposite opinions about 'the US government' based on their different perceptions of its activeness -- Sam thought the topic was boring because 'it's like sitting around and stuff', while Adam saw it as interesting because 'it's always changing. It's different changing patterns'.

A new attribute dimension emerging from the interview data was how *challenging* a topic was perceived by the participants. Not surprisingly, topics that were appropriately challenging were deemed interesting. For instance, when asked why 'fractions and proportions' was uninteresting, Lauren said: 'They're really easy… sometimes I'd really like to have a challenge. And fractions and proportions, I understood immediately' (Interview-Lauren). Similar views were expressed by other participants on various topics.

Minor Topic Attribute Dimensions. Interestingly, the *cool* attribute dimension did not emerge from the interview data as a significant influencing factor of topic interest. Only two interviewees, when commenting on the topics 'video games' and 'basketball', hinted at the popularity of them among friends. This pattern was inconsistent with the MDS analysis results in which the *cool* dimension was shown as a significant influencing factor. One possible reason is that the interview questions asked the interviewees to focus on the characteristics of the topics themselves, which might have discouraged them from thinking about how the topics were perceived among peers. It is also possible that interviewees may be (consciously or not) unwilling to embrace peer influence as an explanation for their interest.

Similar to what the MDS analysis suggested, the interview data provided little support to the speculated *typical of school* and *mysterious* attribute dimensions. The *typical of school* attribute dimension was only brought up by two interviewees when discussing the topic 'video games' – 'It's fun, unlike some things we do at school' (Interview - Lauren). No direct reference to the *mysterious* attribute dimension was made by the interviewees, although two of them suggested that things with uncertainty, either uncontrollable or having various possibilities were more interesting – For instance, Adam found 'how cells work' interesting because '…they just work by themselves, that humans don't really control', and Paul expressed an interest in 'fractions and proportions' because 'it's like a mystery kinda. There are different ways of doing it'.

Non-Topic-Attribute Factors. Though not the focus of this study, the interview data also suggested factors other than topic attributes that might play a role in topic interest development. The most salient one is participants' interest in the broader domain to which the topic belongs – that is, their interest in the domain determines whether they found the topic interesting. This pattern was particularly obvious for the math topics and the topic 'how animals survive in the wild'. For example, when asked about specific math topics, Linda said: 'I hate math. I hate anything that's included with math…It's so boring. Anything related to math is boring'. Similarly, when asked to explain why 'how animals survive in the wild' is interesting, Lauren responded: 'I don't know. I've always been interested in animals'.

Among the science topics, 'why junk food is bad for us' seemed to be an exception both in terms of its interestingness rating and its location in the MDS configuration. The interview data suggested a unique factor that could explain such 'odd behavior.' Three interviewees categorized this topic as uninteresting for a similar reason – 'I love junk food, so I don't want to know it's bad for us' (Interview-Linda). It seems that in this case, a clear implication of the topic conflicted with participants' personal preference, which elicited a negative feeling toward it, and thus low interest in learning more about it.

Lastly, consistent with previous research findings (Bergin, 1999; Mitchell, 1993), half of the interviewees mentioned that the way in which a topic is taught also affects how interesting it is perceived. Two particular teaching methods were reported to enhance a topic's interestingness – using visual representation such as movies or demonstrations, and embedding the topic in individual or group projects.

General Discussion

By analyzing the paired-comparison preference judgment data, I identified four topic attribute dimensions – *active, cool, important* and *familiar* – that influence participants' perception of how interesting a topic is. Among these attribute dimensions, the *active* and the *cool* dimensions seem to be the most important ones (see Table VI and Table VII), which suggests that topics that are considered dynamic in nature or popular among peers are more likely to be perceived as interesting. Interestingly, however, while the interview data confirmed the positive relationship between a topic's activeness and interestingness, interviewees did not place an emphasis on how cool a topic is or how popular it is among peers as an influencing factor of topic interest. These seemingly contradictory results bring up the possibility that the perceived *coolness* of a topic could very well be the result of its interestingness – that is, a topic may become popular because it is interesting, rather than the other way around. In this regard, the *active* attribute dimension seems to be a more robust factor that influences topic interest development, since it is unlikely that participants' view of how active a topic changes as a result of their interest in it.

Extending previous studies that identified content topics students are interested in (Dawson, 2000; Jekins &Nelson, 2005), this finding suggests that instead of generating a list of topics alone, it might be more useful to examine why students perceive certain topics as more active than others. For the data presented here, it is easier to understand why ‘video games’ and ‘basketball’ were perceived as active in nature, but the reasons are not so clear for ‘stars and planets’. Thus, if we could understand what kind of experiences shape students’ perception of a topic’s activeness, we would be in a better position to provide students with such experiences in order to help them view the topic as active, and hence interesting.

Though not as strong as the dimensions *active* and *cool,* both the MDS analysis and the interview data suggested that how *important* a topic is may influence how interesting it is thought to be. More precisely, topics dealing with materials relevant to participants’ lives – either about their own lives, the physical environment they live in, or the society to which they belong – are considered more important, and thus more interesting. This observation echoes previous studies that suggested positive impact of personal relevance on interest (Schank, 1979; Schraw, Flowerday & Lehman, 2001), and on similar constructs such as motivation (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Eccles & Wigfield, 1992). What is rather surprising, however, is that the participants seemed to view math topics as irrelevant to their lives, a rather alarming message that was revealed by both the questionnaire and the interview data. This observation is also reflected in the relationship between how *familiar* and interesting the topics are perceived to be. Figure 2 suggests the general trend that things participants personally experience or encounter more often in their daily lives are high on the familiarity dimension, and math topics once again were not high on the list. Part of this disconnection could be due to the design of traditional math curricula, as they have been often criticized for portraying math as irrelevant to students’ lives (Mitchell, 1993; Popkewitz, 1988; Wu, 1996). But the finding also points out the need to give students more out-of-school opportunities to engage in activities involving mathematics. Such exposure conceivably would help students perceive math as more familiar and relevant, and thus more interesting.

It should be pointed out that these four attribute dimensions are unlikely to be the only, and possibly not even the most significant dimensions that influence students’ topic interest. The *challenging* attribute dimension that emerged from the interview data provides a good example of other possibilities. As the appropriate level of challenge has been suggested to influence short-term interest elicitation (Hidi & Baird, 1986) and to enhance motivation (Csikszentmihalyi, 1990), it is conceivable that a topic’s *challengingness* may also play a role in topic interest development. This possibility, together with other unidentified factors, need to be further explored in follow-up studies.

The methodological approach used in this study, particularly the coupling of paired-comparison preference judgment task with MDS analysis, has proved to be successful. By moving beyond the previous strategy of identifying content topics students are interested (or uninterested) in, this approach allowed us to begin to understand *why* students find certain topics more interesting than others. As Jenkins and Nelson (2005) pointed out, the topics individual students express interest in often appear idiosyncratic in nature, which makes them less useful in guiding curriculum development. However, if we could understand the common features that underlie the topics of high (or low) interest, we might not need to worry as much *what* topics we teach that interest students; instead, we could focus more on creating environment, context, or means in which a particular topic is taught so that it is perceived as more active, familiar or important, and thus more interesting.

Limitations and Future Directions

In this study, I was able to identify a set of topic attributes – *activeness, coolness, importance, familiarity,* and possibly *challengingness* – that influence middle-school students' topic interest. In addition, the data also suggested non-topic-attribute factors that possibly affect how interesting a topic is perceived to be. While identifying these factors is an encouraging step toward answering the question 'what makes a topic interesting', the present study also raised several issues that need to be addressed in future studies.

First, it is unclear how the term "interest" was understood by the participants. The interview transcripts suggested that students often equated "interesting" with "fun", "liking", or simply "willing to do", which possibly represented different constructs. While this lack of clarity is understandable given the flexible use of the word "interest" in everyday language (Valsiner, 1992), it nonetheless points out the need to define "interest" more precisely in follow-up studies.

Similarly, the 'purity' of the topic attribute dimensions identified in this study is unclear. That is, it is uncertain whether the participants interpreted the attribute dimensions in the same manner. Despite the fact that brief definitions of the attribute dimensions were provided at the time of questionnaire administration, it is quite likely that participants interpreted the dimensions differently from the definitions, and different students assigned slightly different meanings to the same dimension. In fact, the interview data suggested that such divergence from the provided explanations, as well as sub-dimensions within each attribute dimension, indeed exist. Therefore, follow-up studies need to separate out these sub-dimensions, and examine their individual impact on topic interest.

Due to practical reasons, the sample size of this study is quite small. While the study design, particularly the use of the MDS analysis technique, allowed us to extract valid information with only a small number of participants (Kruskal & Wish, 1978), it should be kept in mind that, to the extent that the results are generalizable, they might well only hold for similar populations. It is likely that different attribute dimensions would emerge with different populations. For instance, as peer influence has been suggested to be the strongest during early adolescence (Berndt, 1979; Steinberg & Silverberg, 1986), it is quite likely that the *cool* dimension identified in this study might not be a significant factor for students of other age groups. Replicating this study with different populations would be an important next step.

Related to the constraint that I only had limited access to a small group of students, the validity and reliability of the instruments used were not established prior to their administration. While detailed instructions regarding how to complete the questionnaires were given to the participants, it is likely that students interpreted the items or even the rating scale differently from the original design. Administrating the instruments to a group of students that are comparable to the participants in this study and examine closely how they interpret and complete the questionnaire items would greatly strengthen the findings.

Lastly, I am uncertain whether students' perception of a topic's interestingness as assessed in this study is the same as that when they are actually engaged in learning about the particular topic. Given the ultimate goal of this research is to inform teaching practice, this distinction is quite important. The interview data implied that even for a topic that is high on all of the identified interest-influencing attribute dimensions, the teaching method through which it is taught could easily make it uninteresting. Therefore, in future work, I plan to explore the influence of different teaching methods on topic interest, as well as their interaction with the identified topic attributes in guiding topic interest development.

Notes

1. In order to differentiate from the configuration dimensions (i.e. the coordinates), the term 'attribute dimensions' is used to refer to the attributes of the topics that may explain their perceived interestingness, represented as additional lines in the configuration (see Figure 2).

2. All student names in this paper are pseudonyms.

3. The frequency of occurrence refers to the number of times a factor was mentioned by the interviewees. Please note that a factor could be mentioned multiple times by the same individual, as the individual could refer to the same factor when discussing different topics.

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Appendix 1: Example items of Questionnaire 1

If you had to listen to someone talking about the topics A and B, which one do you think you'd find more interesting? Highlight it!

1	A)	Why junk food is bad for us	B)	Earthquakes and volcanoes
2	A)	Charts and graphs	B)	Stars and planets
3	A)	Different cultures and countries	B)	Why junk food is bad for us
4	A)	Stars and planets	B)	Basketball
5	A)	Forces and gravity	B)	Earthquakes and volcanoes
….				

Rate HOW interesting you think each of the following things is using this A-D scale:

A	B	C	D
Very **Un**interesting	Somewhat **Un**interesting	Somewhat Interesting	Very Interesting

For each question, highlight the letter that best describes your opinion. Make sure that you highlight **one, and only one**, letter.

121	How cells work	A	B	C	D
122	How animals survive in the wild	A	B	C	D
123	Forces and gravity	A	B	C	D
124	Earthquakes and volcanoes	A	B	C	D
….					

Appendix 2: Example items of Questionnaire 2

Some things are more active, and others are more passive. Active things often have lots of energy, involve many activities, or change a lot.

How ACTIVE do you think the topic is?[1]

Circle the number that best describes your opinion. Please circle one and only one number.

	Not Active at all →				Very Active
How cells work	1	2	3	4	5
How animals survive in the wild	1	2	3	4	5
Forces and gravity	1	2	3	4	5
Earthquakes and volcanoes	1	2	3	4	5
Sexual reproduction in animals	1	2	3	4	5
The US government	1	2	3	4	5
How pollution harms the environment	1	2	3	4	5
Fractions and proportions	1	2	3	4	5
….					

[1] The same questionnaire format was used for the other five attribute dimensions.