

The potential of negative motivation.

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Abstract

Recently there has been an increased interest in exploring the relationship between Technology Enhanced Learning (TEL) and Motivation. Both areas have large bodies of research already. Both have well established theories like Mayer's Cognitive Theory of Multimedia Learning (CTML) and Self Determination Theory of motivation.

From the TEL perspective the call is driven by the fact that theories such as CTML are global and do not take motivation into account. This study sought to remedy this dearth and investigate the effect of motivation on Modality, one of the ten principles of CTML.

Modality holds that better learning occurs when materials are presented as audio/visual rather than on-screen text/visual. Modality has not traditionally been tested in this fashion.

207 5th year students participated in an experiment to investigate the effect of Motivation on Modality. The results of the research did not show support for the hypothesis in relation to the positive forms of motivation. However, the negative form of motivation, amotivation, did show significant interaction, where highly amotivated participants performed significantly better with traditional text/video materials rather than the audio/visual format, the opposite of modality, known as reverse modality.

The results provide three interesting insights, which might guide instruction and provide areas for future research. First, is amotivation a more sensitive measure of engagement level than motivation? Second as amotivation is a barrier, it may be susceptible to being removed using methods such as context and defining learning steps, thereby motivating learners.

Finally the amotivated performed better with traditional, rather than multimedia materials (reverse modality). Could learning materials in the future be personalised to suit amotivation levels?

Keywords: Amotivation, Modality, Motivation, Multimedia Learning, Cognitive Load Theory

1 Introduction - Background and Context

Teaching and its associated materials are in a period of change. As technology becomes faster, cheaper, accessible and more reliable its uptake becomes more desirable.

In Ireland the Department of Education and Skills states that one of their four focus areas is, “Integrating information and communication technology (ICT) within the curriculum and providing curriculum relevant digital content and software”, (2011).

This uptake in technology-enhanced learning is across the globe, as a result the need to research how people can benefit from learning through technology becomes more necessary. In fact the researcher on this paper works in the Learnovate Centre, a TCD hosted research centre dedicated to the area of TEL.

1.1 Cognitive Theory of Multimedia Learning

In relation to how the most effective learning materials are developed, Richard Mayer established the Cognitive Theory of Multimedia Learning (CTML) (2002). The theory holds that if certain principles are followed in the development of learning materials, better learning will occur. The theory is a widely supported one and comprises 10 principles. One of the most persistently supported effects is modality (Mayer, 2008). Modality holds that if materials are presented in audio/visual fashion, better learning occurs than through on-screen text/visual. Importantly, CTML is a global theory, it tends not to look at context or motivation (Mayer, 2008).

1.2 Motivation

Motivation has long been seen as an important element of learning and there are many strong theories of motivation. One well-supported and multi-dimensional motivation theory is Self Determination Theory (SDT), (Deci and Ryan, 2008) explained in section 2.3 of this paper.

Situational Motivation refers to the motivation an individual has to engage with an activity, at a given moment in time (Guay, Vallerand, and Blanchard, 2000). It can be influenced, by mood at the time, rewards offered etc. This form of motivation aligns well with the concept of engaging with a learning activity, the focus of this research.

One interesting dimension of SDT is Amotivation, it is the negative form of motivation, where participants see the outcome of an activity as neither desirable nor attainable.

1.3 Technology Enhanced Learning and Motivation

Recently there has been a call from experts in the area of technology enhanced learning to examine the relationship between motivation and technology enhanced learning, as it is felt that while there is a lot of work to date in each area, there has not been much research in the interaction of the two (Small, 2011), (Mayer, 2011).

1.4 The Research Question

The original research this paper is based on looked at various dimensions of situational motivation for their impact on the established concept of modality.

The initial thoughts around the research were if people are highly motivated then the delivery method would not be as critical. By way of elaborating this point, consider a person stuck in a burning building, and the route to safety is drawn poorly on a scrap of paper, the individual will engage with the material because they are very motivated to do so, albeit an extrinsic motivation (motivated by the promise of reward).

In the original research the only dimension studied showed significant impact was:

What effect does amotivation have on modality?

One other sub question that revealed interesting results was in relation to gender and modality.

2. Literature Review

2.1 Modality Principle.

As mentioned earlier, Mayer reported strong evidence of modality principle, support was shown across seventeen experiments using various types of lessons. Performance was based on transfer tests which go further than knowledge acquisition and test understanding by posing questions as to how participants would use the newly acquired knowledge rather than recall alone (Mayer, 2008).

In opposition, Rockwell and Singleton's research on information acquisition/recall showed support for Moeller's single channel theory of multimedia (Rockwell and Singleton, 2007). The experiment involved a linear 2D style presentation in three formats; text only, text/audio and finally a text/audio/video presentation, where the video was of a presenter reading the material. Results showed the best performance in the text only scenario, it is proposed that the results might be due to participants perceiving the media rich versions as easier and therefore not committing as much effort in the learning exercise (Rockwell and Singleton, 2007). It should be noted, none of the three conditions in this would equate exactly to modality. Another point is that the video was the presenter talking to camera, and therefore this was not bringing any further meaningful information to the process, (Rockwell and Singleton, 2007).

Finally, while modality principle is still strong in terms of supporting evidence there is also evidence to point to the specific circumstances under which modality occurs. Guan (2009)

holds that modality works where there is ‘a short piece of information with a limited fixed learning time’.

2.1.1 Gender and Modality

In a study using a version of modality effect, gender was seen to play a role where the objective was information transfer to new contexts (Flores, Coward and Crooks, 2010). The two conditions were a) text only and b) text/audio, females performed better in condition ‘a’ while males did better in the dual presentation mode ‘b’, (Flores, Coward and Crooks, 2010). Note again these are versions of modality not exactly in line with Mayer’s modality principle.

Desk research showed one recent direct gender comparison in modality effect. The research showed no significant difference in a small-scale vocabulary lesson (Zareia and Khazaie, 2011). Research looking at other aspects of multimedia learning shows mixed results in gender differences (Passig and Levin, 2000), (Papastergiou, 2009).

2.1.2 Seductive Details and Modality

Seductive details in multimedia are aspects that are considered interesting but unrelated to a learning outcome (Park, Moreno, Seufert and Brünken, 2011). According to multimedia learning theory seductive details would be considered additional to the required learning and therefore impede performance in line with coherence principle, which holds that material not relevant, causes extraneous load (Mayer, 2002). Research looking at the effect of seductive details showed that in a modality situation seductive details fostered learning in the audio/visual format but not in the text/visual format, the authors hold that these more interesting elements may have improved the participants’ germane load/motivation to learn (Park, Moreno, Seufert and Brünken, 2011).

2.1.3 Redundancy Effect and Modality

Redundancy effect refers to the detrimental impact of extra non-essential information on learning (Mayer, 2002), but what is redundant for one person may not be for another, a level of expertise may mean that visual assistance is not required and therefore its presence is redundant, while for a more novice learner its presence will benefit learning, this principle is known as expertise reversal effect (Kalyuga, 2007). In a research project with schoolchildren aged 11 and 12 years old, expertise reversal effect was shown in the older children who were already familiar with the science-learning concept (Leslie, Low, Jin and Sweller, 2011). This finding has potential impact on modality principle in the sense that at a certain stage of knowledge acquisition it

implies that extra visual stimulus becomes redundant, but as Leslie et. al. (2011) point out, at what stage?

2.2 Motivation

Motivation has many definitions, in broad terms the definition provided in the Oxford Dictionary of Psychology covers the common aspects, it reads “Motivation n. A driving force or forces responsible for the initiation, persistence, direction and vigour of goal directed behaviour”(Colman, p.479, 2006). In accepting these definitions motivation would be considered a positive force. In addition, motivation has been shown to be a universal theme, even in cultures that do not place much emphasis on individual performance, (Deci and Ryan, 2008).

In terms of education, motivation can be seen as a quality a student possesses, but it is more likely to be subject weighted. Some children might like, or be motivated in maths but do not like languages, so motivation in education can be context-specific (Long, Wood, Littleton, Passenger and Sheehy, p111, 2011). Motivation is also not just about the level of engagement with a topic, but also the nature of that involvement, (Long et. al. p.111, 2011).

2.3 Self Determination Theory (SDT)

SDT has been around for a long time, it is one of the more robust theories of motivation. Since its introduction in 1985 it has been cited regularly and continues to be used extensively to date in areas such as sport, education and healthcare (Deci and Ryan, 2008).

Other motivation theories are focused on the concept of individual difference, looking at the different motivations and drivers individuals have. SDT does the opposite, it focuses on three psychological needs people consistently seek to satisfy across culture and domain, they are Autonomy, choosing to engage in a task or activity, Competence, the sense of ability to achieve the desired outcome, and Relatedness, feelings of connection in one’s interactions, (Milyavskaya and Koestner, 2011).

A main strength of SDT is the approach to measuring motivation. Other theories look at motivation as a unitary concept, SDT considers three broad components; intrinsic motivation, extrinsic motivation and amotivation, (Deci and Ryan, 2008). The next few sections describe the three core components of SDT in some more detail, as they are the building blocks for this research study. This three pronged approach to measurement provides insight, as it is the type of motivation a person has in a situation that is more

important than the overall motivation when predicting scenarios such as creative problem solving and deep conceptual learning (Deci and Ryan, 2008).

2.3.1 SDT - Intrinsic Motivation

In relation to education, intrinsic motivation would be described as the internal desire to engage with a topic for its own sake. The rewards would be internal satisfaction, the search for a greater level of proficiency and understanding of a subject area (Vallerand et al. c.f. Barkoukis et al. 2008).

2.3.2 SDT - Extrinsic Motivation

Extrinsic motivation in education would link more to behaviouristic methods of reward for good behaviour (Long et. al. p.111, 2011). The reward need not be instant gratification such as test results, it may have other reward aspects to it such as peer opinion or to avoid punishment. In brief, engaging in behaviour as a means to an end, (Barkoukis et al., 2008).

2.3.3 - Amotivation

Intrinsic and extrinsic motivation both result in goal driven and focussed behaviour, amotivation is the opposite, there is a lack of motivation or direction in behaviour, (Deci and Ryan, 2008). Amotivation is associated with individuals feeling some or all of the following, lack of ability to engage with the subject, a belief the outcome is not desirable, the subject is too demanding for them and finally that even with great effort successful completion is not possible (Barkoukoukis et al, 2008).

In specific situations amotivated individuals tend to show a lack of autonomy and have no motivation, they feel incompetent (Deci & Ryan, 1985). An Australian research project with high-school students looked at occupational amotivation and found a significant relationship between occupational amotivation and occupational indecision where they felt what ever choice they made would have little impact on the outcome (Junga and McCormick, 2010).

2.4 The Situational Motivation Scale

The Academic Motivation Scale (AMS), measures intrinsic and extrinsic motivation toward education (Vallerand, 1992) and has been shown support in other research (Barkoukis, Tsorbatzoudis, Grouios and Sideridis, 2008). Vallerand, Guay and Blanchard developed the Situational Motivation Scale (SIMS) from the AMS, (Guay, Vallerand, and Blanchard, 2000). The scale is closely related to self determination theory, comprising a sixteen item self-report questionnaire with sub scales that allow measurement of intrinsic and extrinsic motivation, and amotivation, (Guay, Vallerand, and Blanchard, 2000). The scale has also been used with participants as young as sixteen making it a usable scale with the participants in this research.

3. Design

The research was investigating the relationship between two variables, motivation and modality. When research seeks to measure ‘observable data on variables’ the method should be quantitative (Cresswell, 2008). This research used quantitative methodology, more specifically a controlled experiment, where the variables were under direct control of the researcher, (Cohen, Manion and Morrisson, 2007).

Data was captured using pen and paper, pre-test (to measure motivation) and post-test (to measure learning gain) sheets. The data was coded in SPSS. Histograms and q-plots were run to check for normal distribution of responses. The research questions were analysed for significant variance using a two-way ANOVA. Three community schools, Naas, Coolmines and Malahide took part. In total 207 5th year students participated, (56 discounted due to a possible confounding effect).

3.1 Artefact

The ideal lesson should evoke a differing level of motivation and at the same time prevent prior knowledge affecting the results. The participants were 5th year students who had started the process of considering what direction they might take after second level. They had been given general advice and already decided on their subjects for the higher level. To this end a career guidance lesson on psychology was chosen. Figures from the Irish Higher Education Authority (HEA) show the number of university enrolments for psychology in 2009/2010, placed the course twenty-first out of one hundred and three courses on offer, ahead of courses like pharmacy, dentistry and accounting (2010). The lesson provided an overview of the roles of four types of psychologist; educational, forensic, health and counselling/clinical.

To ensure that a) modality was the only difference and b) that best design practice was followed in line with Mayer’s other principles. The same video was edited in two formats both use the same visual and timeline.

An introduction script gave the participants information on the purpose of the research, and the process involved, a script was used to insure the same information was given to each group. The final artefact was an audio clip that provided context for the main video lesson. The information in this audio clip was crucial, it was the material that would elicit the level of motivation from the participants. For this reason the information was delivered by audio clip to ensure content, voice and intonation were equal in delivery of the message.

The purpose of the research was to investigate the effect of situational motivation on modality. To maximise the learning experience the learning materials were designed in line

with Mayer’s principles of good design (Mayer, 2008), avoiding possible confounding of the research by either seductive details, or by extraneous items leading to redundancy effect.

Principle of Good Design	Rule	Design approach
Spatial Contiguity	verbal and visual should be presentated in a meaningful integrated fashion	In the text version the subtitles were timed to coincide with the relevant imagery
Temporal Contiguity	corresponding verbal and visual information should be presented simultaneously	Imagery was timed to work with the narrative in both versions
Redundancy Effect	Presentation of the same information in too many modalities will cause unnecessary load	In the voiceover version the subtitles were omitted
Coherence Effect	The inclusion of non meaningful elements on screen should be avoided as much as possible	No unnecessary imagery was used in the production

Table 1. Multimedia principles and how they were facilitated in the artefact

3.2 Design of the Learning Experience

To effectively cover the number of participants required for the research, the learning had to work in the typical 40-minute class session. This timed approach is also more conducive to promoting modality effect, support has been shown for self-paced learning having a confounding effect on modality (Guan, 2009).

The pre-test questionnaire was to establish motivation levels. The learning experience was to give participants an understanding of the wide and varied roles psychologists play in working life. The participants were recall tested on the material they had been presented. They were also asked transfer test questions, applying the learning by answering questions about what they thought other types of psychologists do, based on the knowledge they had gathered.

3.3 Data Collection Methods

The data recorded during the research was entirely pen and paper format and consisted of two sessions providing the following Data Sets:

- Gender
- 5 point Likert scale on current knowledge of psychology
- Situational Motivation Scale (SIMS).

- A scale score of performance in the rote and transfer test learning.

3.4 Data Analysis

The scores were checked for normal distribution using a histogram showing normal curve plot. The data was analysed using a two-way ANOVA as it allows investigation where there are two independent variables, giving an understanding of the effect of each, and the joint effect of both, (Smithson, p.347, 2000).

3.5 Participants

The 207 participants were from three secondary colleges in Dublin. Each school provided two mixed ability classes. One school provided two additional classes, however after the experiment it came to light that these two classes were very different in terms of academic ability. On comparing their results it was deemed unsafe to include their contribution, as the differences were extreme. This meant the final number of participants was 151. A small Pilot test was run using three students of the appropriate age and slight adjustments were made.

3.7 Ethics

Prior to engaging with schools, guardians, or students, research ethics were sought and received from the School of Computer Science and Statistics Research Ethical Committee, Trinity College, Dublin.

4 Findings

4.1 Overview

To establish a base to work from it was important to show the two core concepts at work. Modality principle and Situational Motivation were tested for across the participants and each was shown to have significant effect in relation to performance, and positively correlated.

Establishing these two factors meant an investigation on how situational motivation impacted on modality effect was valid. However when the control and experimental results were compared across three positive dimensions of motivation no significant results were found.

In reflecting on why the expected results did not appear, possibly the initial analogy about finding the way out of a burning building is more based on survival, a different emotion than the interest and curiosity associated with motivation.

A one-way Anova was used to see if the level of prior knowledge of the topic had any influence on score, no significance was found therefore all results were analysed.

4.2 Was there evidence to support the idea that Amotivation impacts on the effectiveness of modality?

For Amotivation a two-way ANOVA did show interaction significance between the effects of Amotivation and Modality on the overall score, $F(1, 2) = 4.421$, $P = .014$.

Note however, as shown in Fig 1, it is reverse modality that is shown, where the text version is scoring better than the audio version. This result is more in line with Moeller's single channel view of multimedia learning as reported in section 2.1.

It is plausible that in such a situation the amotivated participants had little option but to engage with the material, this could also go some way to showing that Mayer's modality view and Moeller's single channel view may have a link to amotivation levels, and are not mutually exclusive. In terms of future study the third aspect for review could be material delivery personalised based on motivation/amotivation levels.

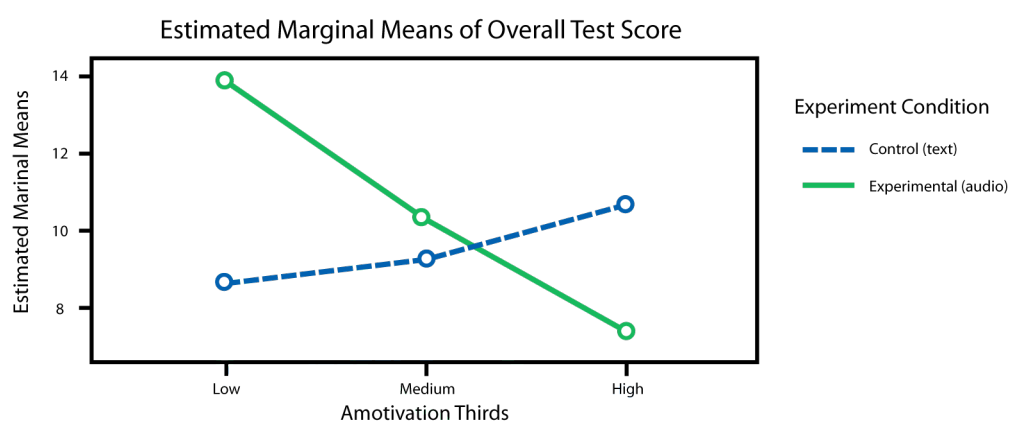


Fig.10 Profile Plot of 'Estimated Marginal Means' of overall test score across Amotivation Thirds by experimental condition.

4.3 Did gender have any impact in relation to Modality and/or Motivation?

As might be expected the split for gender did not reveal any significance in the research question. As an aside, with Modality Effect on its own males showed significant effect while females did not, showing support for some of the ideas looked at in section 2.1.1 that males and females do learn in different ways. The results indicate that females are more resilient in terms of message delivery.

5. Future Work.

The finding in relation to gender shows further support for the concept that gender has an influencing effect in learning and may contribute to future studies, this research implies that

females are not as dependent on the delivery method while males need the entertainment of the multi-media delivery.

While amotivation was not the sole purpose of the original research it has turned up interesting findings. Deci and Ryan describe amotivation as a lack of motivation (2008). Barkoukous describes it as, “a belief the outcome is not desirable.... that even with great effort successful completion is not possible” (2008). The terms ‘a belief’, ‘not desirable’ and ‘even with great effort’ imply a strong emotion as opposed to the term ‘lack’ used by Deci and Ryan, which implies apathy. If amotivation is the lack of motivation why did it show significance when the three positive forms of motivation did not? If amotivation were a lack of emotion one would have thought it might be even less responsive to other factors.

This is possibly the important finding of this research, amotivation appears to be an active negative form of motivation rather than a lack of it, and possibly a more sensitive guide of engagement level, yet to date there appears to be little research into it as an independent motivation paradigm. The potential of amotivation seems to be worth following. Three insights to guide instruction or fuel further research could be.

First, if as this research suggests amotivation is a sensitive measure of engagement level, its development and adoption could provide tools in the future to quickly and accurately gauge the level of motivation at an individual or class level.

Second, as a negative emotion, amotivation can be seen as a barrier to be removed rather than the more complex task of trying to motivate. Treatment of the identified causes of amotivation could be a powerful method of motivating students. For example where amotivation is high, the idea that a task is unattainable could be dealt with by breaking it down further, while context and big picture discussions could assist in positioning why the outcome is desirable.

Third, why was modality reversed for amotivation? Could it be that where amotivation is high a participant might find it easier to let an audio/visual presentation wash over them? Where in the case of a silent text presentation, the process of engaging with the reading aspect means a higher level of concentration is required, even if motivation is low, therefore better outcomes. As the ability to deliver personalised learning becomes more a reality day by day, maybe amotivation is another personalised aspect that can contribute to the solution.

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