A set of criteria to assess motivation and/or persuasion of elearning applications

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Motivational factors have long been a topic of study in elearning applications and there is a strong overlap between these factors and the persuasive factors. This study intends to investigate this overlap. Which criteria are common to both, and which criteria are specific to each? The objective is ultimately to design an interactive persuasion criteria grid that is specific to elearning along the lines of an existing grid, while taking into account the body of research on motivational factors in elearning.

To investigate these questions, we compare the *persuasion* grid of Némery, Brangier, and Kopp (2011) with a number of the *motivational* criteria of de Vicente and Pain (2002), and apply both approaches to evaluate the quality of an elearning application to induce motivation to learn.

1 Introduction

Few would question the power of some games to immerse their users in a state of regular and intense usage for long periods of time. The same observation can be said of some social sites. In that respect, these applications can be considered as reaching a high score on the persuasive scale. Incidently, they are the same persuasive ingredients that designers of elarning applications would like to assimilate to bring learners to use these applications more intensively and effectively.

However, motivational factors have long been a topic of study in elearning applications (see Malone, 1981, for eg.) and there is a strong overlap between these factors and the persuasive factors. This study intends to investigate this overlap. Which criteria are common to both, and which criteria are specific to each? The objective is ultimately to design an interactive persuasion criteria grid that is specific to elearning along the lines of an existing grid by Némery et al. (2011).

To investigate these questions, we compare the *persuasion* grid of Nemery and Brangier (Némery et al., 2011) with a number of the *motivational* criteria from de Vicente & Pain, 2002, and apply both approaches to evaluate the quality of an elearning application to induce motivation to learn.

The persuasion grid was shown to help experts and, in particular, novices to identify weaknesses and potential improvements to improve the persuasive features of applications (Némery et al., 2011). It is

composed of eight criteria and 23 sub-criteria. These eight criteria are credibility, privacy, personnalization, attractivity, sollicitation, priming, engagement, ascendency.

In the field of elearning, motivational scales were developed to assess the quality of an elearning application to engage the learner. The motivational criteria set of de Vicente and Pain (2002) is one such scale that is geared towards the assessment of motivation. It contains nine criteria: control, challenge, independence fantasy, confidence sensory interest, cognitive interest, effort, and satisfaction.

Both the persuasion grid and motivational criteria will be described and compared on a theoretical basis. Multiple dimensions will be investigated: intrinsic motivation vs. persuasive technology, sense of freedom vs. freely accepted compliance, and learning efficacy vs. learning enjoyment. This comparison will set the stage to an experiment on the analysis of an elearning application on math.

The experiment consists in analyzing a drill and practice application in college mathematics. In the tradition of ergonomic inspection, the application will be analyzed by two experts with the persuasion criteria grid and with the aim to identify strong and week elements and to suggest improvements. The same process will be conducted with motivational criteria taken de Vicente and Pain (2002).

The elements identified by each approach will be compared over their similarity and differences, on a qualitative as well as a quantitative perspective.

2 Heuristic inspection

The Némery et al. (2011) grid relies on the general technique of inspection. To inspect the usability of a product, whether a user interface or any artefact designed to be used by some user, is to make a judgment about its ability to be effective, efficient, error-tolerant, easy to learn and satisfying. This judgment is made by experts in ergonomics or HCI.

Inspections are often the method of choice to quickly target usability issues and find the proper corrections to bring to the design of an application.

2.1 The persuasive criteria grid

In field of education, interfaces are becoming more and more engaging in order to encourage learners towards reaching learning objectives. Ergonomic inspection has long been considered to be a part of the evaluation of design processes, persuasive technology has not yet been taken into account. Faced with the lack of validated tool in this area, a set of criteria was elaborated (Némery et al., 2011). Following the review of 164 papers in the field of captology, eight criteria were considered to encompass the persuasiveness factors: credibility, privacy, personalization, attractiveness, solicitation, initiation, commitment and ascendency. These criteria are grouped under static and dynamic categories:

- Static criteria are prerequisite elements to establish a fertile context within which a dynamic process of persuasion can be launched. These prerequisites promote the acceptance of a persuasing process.
- Dynamic criteria are involved in a process designed to engage the user in a series of planned and ordered persuasive steps in which the temporal factor is critical. At each step of the behavioral changes, elements of the interface bring the user to commit to greater levels of engagement.

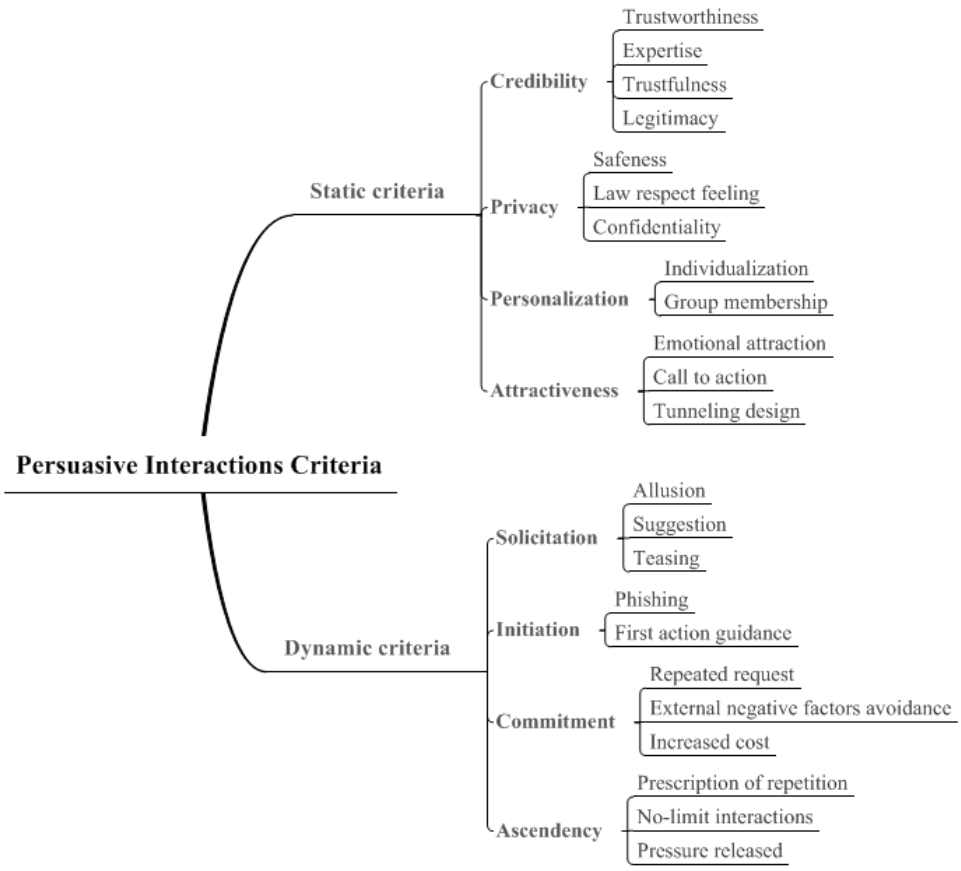

Figure 1: General architecture of the eight persuasive interactions criteria (Némery et al., 2011).

The criteria are described in details below:

Credibility is the ability of the interface to inspire confidence and to make the user confident in the veracity of its information. Credibility is based on reputation and notoriety.

Privacy refers to the protection of personal data and the preservation of personal integrity and security of the interaction. It also refers to protection against loss, destruction or inadvertent disclosure of this data (Liu, Marchewka, Lu, & Yu, 2004). of rights and ensuring the confidentiality of information.

Personalization refers to the concept of customization of the interface to the needs of the user. The customization can be a greeting, a promotion, or any means to achieve a more personal interaction with the user. It may also rely on group membership.

Attractiveness is the use of aesthetics (graphic, art, design) to capture the attention of the user, to support the interaction and create a positive emotion. The animation, colors, menus, drawings, video films are designed to catch and maintain the interest of the user.

Solicitation is the first of the four dynamic criteria. It refers to the initial stage which aims to swiftly attract and challenge the user to initiate the relationship. The interface attempts by words, graphics or any form of dialogue, to suggest a behavior and induce action through minimal influence.

Table 1: Motivational criteria of Vincente and Pain

Variable	Definition
Control	Degree of control that the student likes having over the learning situation (i.e. does he like to select which exercises to do, in which order, etc. rather than let the instructor take these decisions?).
Challenge	Degree that the student enjoys having challenging situations during the instruction (i.e. does he like to try difficult exercises that represent a challenge for him?).
Independence	Degree that the student prefers to work independently, without asking others for help (i.e. does he prefer to work on his own, even if he finds some difficulties, and try to solve them by himself rather than asking for collaboration or help from others?).
Fantasy	Degree that the student appreciates environments that evoke mental images of physical or social situations not actually present (i.e. does he like the learning materials being embedded in an imaginary context?).
Confidence	Refers to the student's belief in being able to perform the task at hand correctly.
Sensory interest	Amount of curiosity aroused through the interface pre- sentation (i.e. appeal of graphics, sounds, etc.).
Cognitive interest	Refers to curiosity aroused through the cognitive or epistemic char- est acteristics of the task (i.e. regardless of the presentation issues, does the student find the task at hand cognitively appealing?).
Effort	Degree that the student is exerting himself in order to perform the learning activities.
Satisfaction	Overall feeling of goal accomplishment (i.e. does the student think that the instruction is satisfying and that it is getting him closer to his goals?).

Initiation refers to elements of the media that allow the first user-initiated actions. The user's attention is captured and, on his own initiative, encouraged to realize the first engaging action. The user is caught in a gradual engagement process.

Commitment means that system further involves the user in a process. Several queries and incentives regularly and gradually engage the user. The electronic media will induce more intensive and regular behavior.

Ascendency is an expression of the completion of the engaging scenario. The user has unequivoquely accepted the logic and goals of the electronic media. The interaction is characterized by induced pleasure and possibly by the relief of internal discomfort. Ascendency is closely related to the concept of immersion in the video game field and it implies a high level of repetition and regularity of interaction, and sometimes emotional involvement in the story that result in dependence and game character identification. Users develop emotional attachment and cannot envision themselves without these product, or would feel a substantive negative effect in case of loss.

2.2 Motivational criteria

As mentioned in the introduction, motivational factors in elearning systems have been the topic of decades of research and we can expect an overlap with the persuasive criteria. We chose the criteria of de Vicente and Pain (2002) as good representatives of the results of this research.

Table 1 summarizes the motivational criteria. They are largely inspired from previous work on what makes an elearning application engaging (see Trân, 2008). We return to their theoretical groundings and to the distinctions and similarities that we can envision between them and the persuasive criteria in the discussion.

3 A case study for the two criteria grids

In an effort to better assess the overlap and the uniqueness of the persuasion and motivational criteria grids, we analyse an elearning application with each of grid. The application is designed for the purpose of drill and practice on the topic of college mathematics. We will refer to it as the Exerciser. It aims to help newly enrolled engineers to assess their level of mastery of college math with respect to the level expected in their first year. If their mastery is lacking on any of topic, or if they want to enhance their skills, the Exerciser contains over 1000 problems and the equivalent of approximately 150 pages of notes that cover the theory. The notes be contextually accessed within the exercise section, and vice-versa.

Figure 2 contains some of the screen dumps of the Excerciser that were used for assessing its persuasive and motivational factors. The assessment is conducted with the aim to address the following questions:

- How heuristic inspection could be done on motivational and persuasive elements situated in HCI?
- What are the explanatory contributions of each grid in measuring the quality of Excerciser interfaces?
- Is there any ergonomic recommendations which can be learned to improve the interfaces?

The Exerciser was analyzed by the two authors who are HCI and elearning experts. Their analysis was done separately and consensually combined in a second step.

3.1 Highlighted deficiencies with persuasive criteria

In terms of **credibility**, the Exerciser's interface inspires confidence trust in the accuracy of its content. Explicit signs of its source and ownership (names and addresses, logo) and the school and professors recognized competence induces a sense of confidence in the learner. The system meets its promise: it contains exercises and solutions in college math.

On **privacy**, personal data and privacy are respected. A commitment is made early on by the site owners to ensure confidentiality and the user is reassured of the absence of risks that establishes a relation of trust.

In terms of **personalization**, only the user name (name, login, code) is explicit. We find no other signs of personalization (greetings, photo, etcl). The interface does not really try to establish personal

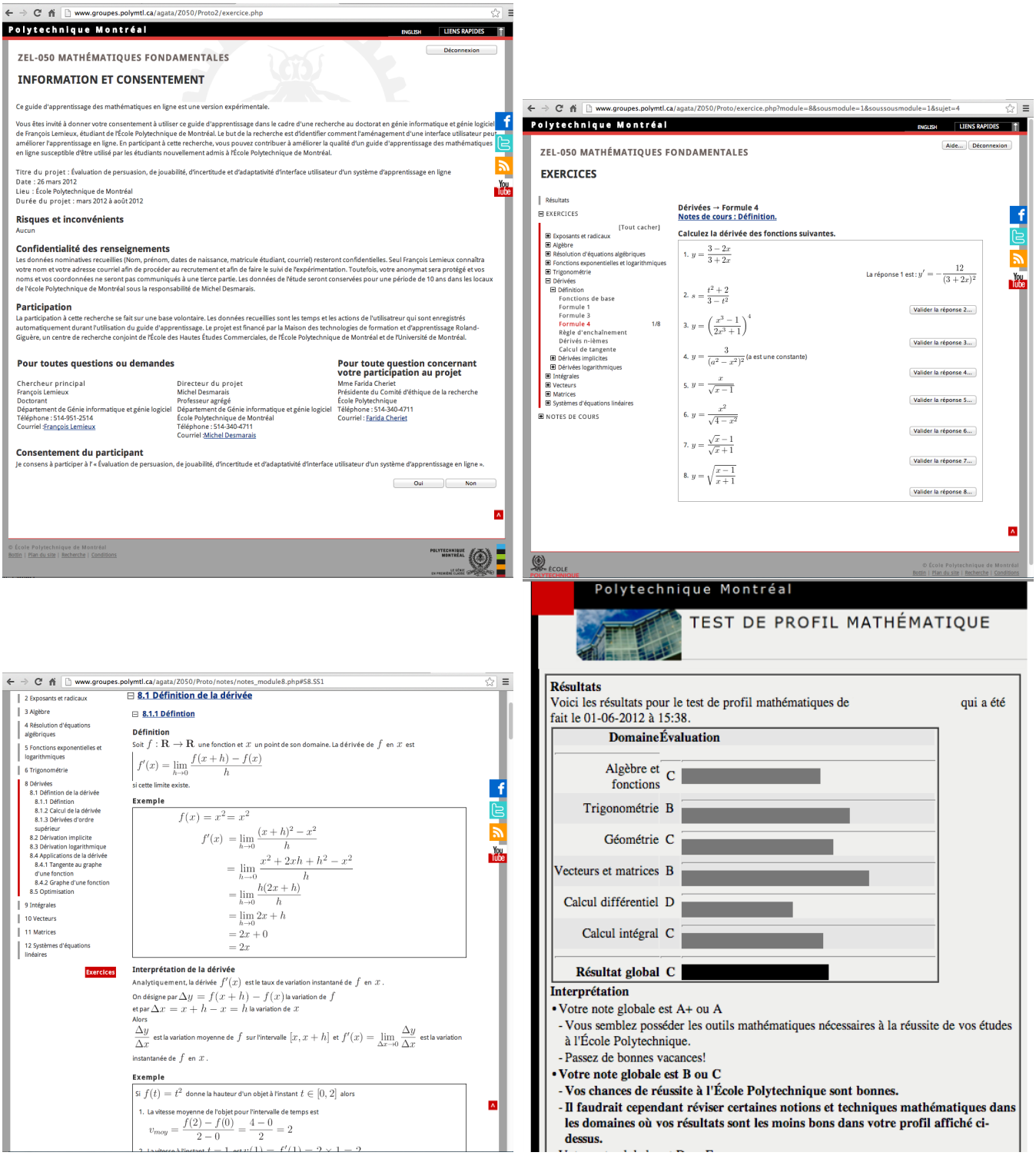

Figure 2: Screen captures of the exerciser.

closeness to the individual. It does not gradually collect the characteristics of the user allowing more personalized messages. Individualized information on the scores and results of the learners are known to the system (figure 2), but they are not used to in messages of support and motivation for the task. Individualization is therefore low. Yet, highlighting individualized features could raise user attention and interest in his/her training task, ultimately fostering engagement. Furthermore, we note that there is no reference to group membership, nor to peer practices and performances and to tutor monitoring or other incentives that could induce some social pressure to engage in the task.

The **attractiveness** of the interface is weak. The aesthetics and appearance are relatively neglected, suggesting a somewhat cold and austere course, rather than the enthusiasm of an original exciting activity. Lack of attractiveness can deter the will to engage in the interaction. We note also that the design does not seek to be as close as possible to the values and needs of students. Finally, we note that the call to action is non-existent: the user is left to himself without a clear plan to follow or task sequencing incentives.

The Exerciser scores low over the dynamic factors. With regards to **sollicition** and **commitment** we note that besides the incentive mail to invite users to the Exercises (figure 2), the Exerciser does not request, hunt for, or encourage learners. Suggestions and teasing that could awaken the curiosity are absent. The same is true for the sub-criterion of the **initiation** of the users who use the system once; they are not guided to undertake a first engaging action. Similarly, the incentives are reduced to the simple presentation of results to exercises (right or wrong), and it is the student himself declares success or failure (see figure 2).

With regards to **commitment**, we note the abence of a student **engagement process** in the design. The inspection of the interaction sequences does not reveal features to involve the individual in an gradual process that would lead to greater engagement towards learning goals. There are no systematic means to stimulate the user. The interface has no explicit feature to attempt to hold the student's attention.

As **commitment** is not supported by the interface, we cannot find elements that would lead to any form of control or addiction of the user.

3.2 Highlighted deficiencies with motivational criteria

The Exerciser gives full **control** to the learner, offering very little guidance apart from the navigation panel that indicates the topics and exercises covered.

The exercises represent a **challenge** in themselves, but the user can always choose to be given the answer instead of being required to find it by himself. This feature reinforses the control given to the user in his learning process, but at the cost of reduced challenge. However, the student can freely choose the exercises at the appropriate level of difficulty.

Learning is designed to be entirely independent, as the learner is not provided support or monitoring, neither from a human tutor, nor from colleagues.

Fantasy is absent alltogether.

Confidence obviously varies considerably depending on student ability and personality, and the criteria should be considered from the perspective of whether the interface supports confidence for students of different profiles. The freedom to choose topics and obtain answers to exercises reduces the chances of feeling overwhelmed by exercices that are too challenging.

Sensory interest of the interface is very low and the comments on *attractiveness* of the persuasive interest apply here as well.

Cognitive interest also varies on a personal basis. From the perspective of HCI and elearning application design, we find few means, if any, that can be leveraged to raise interest and that do not overlap with the other criteria.

Effort refers to a measure of use and cannot be derived from the interface itself, therefore it does not apply to a heuristic evaluation. However, from Lemieux, Desmarais, and Robillard (2013), we have evidence that cognitive interest is generally low, with about half of 117 users spending less than an hour of total use. Yet, about 10 users spent over 10 hours and up to 140 hours, confirming that individual differences on the cognitive interest is highly variable.

Satisfaction is yet another factor that is assessed empirically instead of by inspection. We have no data to assess it for the Exerciser.

4 Discussion

We first note that some motivational factors of de Vicente and Pain (2002) are not defined for an inspecion process, namely *effort* and *satisfaction*. These can only be realistically assessed through experimentation.

However, given that we had data on the time spent by each student and the number of exercises completed, it must be emphasized that the array of levels of usage varies extensively, from a few minutes to over 100 hours. A reasonable interpretation is that some other factors are highly variable across individuals and is a determining factor that can overshadow all others. The most likely factors in are analysis are the *cognitive interest* or the *challenge*, and possibly a factor that is absent from de Vicente and Pain (2002) motivational criteria: the **perceived value**, which represents the importance that the learning goal represents to the user.

Another notable observation from the data is that about half of the users spent less than an hour in total, sometimes only a few minutes. Would this suggest that they do not have the same level of cognitive interest in mathematics or that they are not challenged by mathematics? Probably not since they have chosen to enroll in an engineering program that is itself challenging and involves mathematics. Can this be attributed to the perceived value of the Exerciser? Namely that they do not see the need to spend time in improving their math skills or the efficiency of doing so with the Exerciser. This is more likely, but it is not the sole interpretation.

Another reasonable interpretation for this lies in the persuasive factors. The low score on the attractiveness criterion and the quasi absence of means to support sollicitation and commitment that would foster a progressive engagement is a sound explanation for the large proportion of users who spend a few minutes exploring the Exerciser without committing to its long term use. We could also refer to the *fantasy* and *sensory interest* as other means that could have been better deployed to address the low engagement.

5 Conclusion

This study aims to uncover the overlap between persuasive and motivational criteria, and the criteria that are unique to each, as well as their respective importance. The intent is that a better set of criteria can be obtained and used in an *inspection* process and help the design of an elearning application.

We find that motivational criteria of fantasy and sensory interest can be considered similar to the attractiveness criterion of the persuasive grid. The persuasive grid has specific criteria such as credibility, privacy, and personalization that are specific. However, all of these criteria are not considered critical to explain the large variance in long term engagement that was observed for the usage of the Exerciser in practice.

Instead, motivational criteria such as cognitive interest, challenge and a criteria absent from de Vicente and Pain (2002), perceived value, are better candidate to explain the high engagement observed for some users. Conversely, the dynamic criteria of the persuasive grid are seen as good candidates to explain why many users did go beyond cursory exploration of the Exerciser.

Finally, we observe that the data on long term usage of the application, which are indicators of the *effort* and possibly *satisfaction* criteria of the motivational factors, were critical in our analysis and cannot be obtained solely from expert inspection of an interface.

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