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Aesthetic Pleasure from Visual Quotes and its Influence on Individuals' Motivation to Exercise

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To Gracinda Gaspar Vieira

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Abstract

It is well-known that physical activity has many benefits for health and well-being. However, one in four adults worldwide does not engage in enough physical activity.

On the other hand, nowadays, many people look for physical exercise motivation online on image-sharing social media platforms, where it is relatively common to find encouraging text messages embedded in visual presentations (as visual quotes).

Considering that perceived beauty can influence our perception of an artifact, this research project explored whether and how aesthetic pleasure affects people's perception of motivational text messages and the textual content's motivating capability on people's exercise motivation. The influence of several aesthetic pleasure levels (ugly, neutral, and beautiful) was explored in textual content with different characteristics (e.g., positive-framed, self-liberating messages, low-perceived competence, high-perceived competence).

Several experiments revealed that high levels of aesthetic pleasure does not necessarily lead individuals to perceive a textual message as more positive. Similarly, low levels of aesthetic pleasure did not affect textual content perception. Indeed, ultimately, the influence of aesthetic pleasure seemed dependent on the textual content's own characteristics.

Some experiments focused on the immediate effect of aesthetic pleasure, while others focused on aesthetic pleasure in the mid-term (over four weeks). In none of the scenarios did aesthetic pleasure influence intrinsic motivation, which has been found to be linked to individuals' enjoyment of and likelihood of engagement with exercise over the long-term, or influence the extrinsic motivation (the identified behavior regulation), related to the initial adoption of physical exercise. Nonetheless, it was found that visual presentations perceived as aesthetically appealing help to instill a positive feeling regarding the textual content. Possibilities for future research are suggested on the basis of Cognitive Evaluation Theory, a sub-theory of Self-Determination Theory).

Keywords: Visual quotes, aesthetic pleasure, visual aesthetics, beauty, emotional design, motivational text messages

Resumo

É de conhecimento geral que fazer exercício físico traz vários benefícios para a saúde e bem-estar. Contudo, um em quatro adultos em todo o mundo não faz exercício físico suficiente. Por outro lado, hoje em dia, muitas pessoas procuram motivação para fazer exercício físico na internet nas redes sociais, onde facilmente se podem encontrar mensagens de texto motivacionais embutidas em apresentações visuais (designadas *visual quotes*).

Tendo em conta que a perceção de prazer estético pode influenciar a nossa perceção sobre um determinado artefacto ou pessoa. Este projeto de investigação explorou se e como o prazer estético pode afetar a perceção de mensagens motivacionais e a capacidade motivadora do conteúdo textual na motivação das pessoas para fazer exercício físico.Foram explorados a influência de diversos níveis de prazer estético (feio, neutro, belo) em conteúdo textual com diferentes características (por exemplo, *positive-framed*, *self-liberating*, perceção de baixa-competência, perceção de alta-competência). Vários estudos (*experiments*) revelaram que níveis de perceção de prazer estético altos não levam necessariamente a que as pessoas percecionem as mensagens de texto como mais positivas. De forma similar, níveis de perceção de prazer estético baixos não afetaram a perceção do conteúdo textual. Em último caso, a influência da perceção de prazer estético pareceu dependente das próprias características do conteúdo textual.

Alguns dos estudos focaram-se no efeito imediato da perceção de prazer estético enquanto outros focarem-se no efeito a curto prazo (até quatro semanas). Em nenhum dos cenários, a perceção de prazer estético influenciou a motivação intrínseca para fazer exercício físico dos participantes, que está associada à prática de fazer exercício físico a longo-prazo; Ou influenciou a motivação extrínseca *identified behavior regulation*, que está associada à adoção inicial de hábitos de exercício físico. Não obstante, verificou-se que as apresentações visuais das *visual quotes* percecionadas como esteticamente apelativas ajudam a incutir um "sentimento" positivo relativo ao conteúdo textual. Por último, são sugeridas possibilidades para futura investigação tendo como base a teoria *Cognitive Evalution* (uma sub-teoria da teoria da Auto-determinação).

Palavras-Chave: Visual quotes, prazer estético, design emocional

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1

Introduction

We live in a digital society in which people want to consume visual content—so much that, in social media, visual layout templates even frame written words [55, 176]. This led us to a question: How do beautiful typographic compositions influence people's perceptions of written content? Do they affect the motivating capacity of this type of messages? Following an exploratory approach and using experimental methods, we tested three hypotheses.

This chapter contextualizes the research, presents the research questions, outlines the research design and its limitations, describes the project contributions, and finishes with a list of published papers.

1.1 Background Context

Globally, 1 in 4 adults does not engage in enough physical activity [119]. Physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally) [118, 123]. Insufficient physical activity increases the risk of diabetes, obesity, brain-cardiovascular diseases, several types of cancer, neurodegenerative diseases (e.g., dementia), anxiety, depression, and stress [61, 102, 119, 124, 172, 177]. The costs of physical inactivity in direct health care to the European economy is over €80 billion per year [6].

Staying active helps to prevent and control such diseases, as well as promote a better sense of well-being. Regular exercise helps to relieve stress, improve memory and concentration, regulate sleep patterns, and boost physical and mental energy, including improving one’s mood [22, 160]. The World Health Organization recommends that healthy adults aged 18–64 years engage in at least 150 minutes of moderate-intensity aerobic activity throughout the week or at

least 75 minutes of vigorous-intensity aerobic physical activity throughout the week (or, an equivalent combination of moderate- and vigorous-intensity activity) [79]. Many individuals who are concerned about health and fitness are excited to try new things that could be beneficial for their physical activity. Fitness and activity trackers (i.e., smart wristbands, sports watches) were the most popular type of electronic wearable devices in 2017, and it is expected that the market will continue growing until at least 2022, in which it is foreseen that sales of fitness/activity trackers will reach 105 million unit shipments and $3.33 billion in revenue [58].

However, a look into academic research poses the question of how effective activity trackers are in terms of motivating people to adopt healthy exercise habits. On the one hand, activity trackers can provide positive, enjoyable, and meaningful experiences that offer psychological benefits. They can create a sense of autonomy (a feeling of being the cause of one's actions) or enhance relatedness when family members join in efforts to promote a healthier self [89]. On the other hand, there is mixed evidence regarding how effective activity trackers are in supporting or promoting behavioral changes. For instance, the addition of an activity tracker to a standard weight-loss intervention did not demonstrate a higher efficacy in decreasing weight in overweight adults [83]. A recent systematic review and meta-analysis (2019) [101] suggested that activity trackers, alone or combined with other intervention components, are unlikely to generate meaningful changes in physical activity behavior. Another study discovered that tracking behavior can undermine intrinsic motivation, which is the type of motivation linked to long-term physical exercise practices [54]. Lastly, another study suggests that activity trackers might not provide sufficient motivation to encourage individuals who are not highly intrinsically motivated to exercise [97]—in other words, to those who have low motivation to exercise.

One of the current strategies that these devices employ is to provide users with textual feedback. Among the main benefits of this strategy compared to visualizing numerical data is the easier interpretation of the meaning of numerical (statistical) data by the user, which can be, for example, particularly relevant in the case of users with low levels of literacy [27]. Moreover, writing can be seen as an efficient way to communicate ideas that can help people deal with a particular problem and provide guidance to actions. Motivational text messages are one example of that. Often, they seek to offer a positive perspective on a situation (problem) so as to provide a momentaneous boost of motivation to continue pursuing one’s goal. Examples from the Runkeeper service are as follows [129]: “If it doesn’t challenge it won’t change you”, “Start where you are. Use what you have. Do what you can”, and “Strength comes from the things you once thought you couldn’t”.

Many researchers have explored the use of text messages to promote physical activity. However, there are still issues to resolve [66, 148]. For instance, the process of creating messages is often not sufficiently clear or lacks a theoretical framework. Also, the non-existence of control groups limits claims and comparisons about the effectiveness of text messages.

In addition to these questions, it is relatively common to see, over the web, encouraging text messages embedded in visual presentations. This trend can be easily observed in social media posts, as well as in big players in the digital industry. For example, in 2016 the largest social media network, Facebook, announced a new feature in its platform that lets users add a background color to text posts [55]. That same year, the multinational software company Adobe Inc. launched Adobe Spark Post, an online and mobile app that helps people create visual quotes (text messages embedded in a visual presentation) with pre-defined visual templates [2]. In the market of activity tracker services, the app Nike Run Club allows users to mix workout photos with text messages and share them on their social media networks.

While this trend can be relatively easily spotted in the digital social world, it is not often the focus of investigation in related academic HCI research. Indeed, the authors often focus on characteristics of writing, such as positive and negative frame and informative versus persuasive [64, 110, 166]. Yet, this is not the scenario in other fields (e.g., social media, public health), where recent studies have suggested that background images containing "body-perfect" or sexualized bodies can have mostly harmful mental health effects, particularly in young women [47, 56, 77].

Research in the field of Human-Computer Interaction has found that the perception of beauty generates excitement (a more positive attitude) through a new product [51, 52, 82, 117, 175]. Following on this, this research explores whether and how aesthetic pleasure affects people's perception of motivational text messages and the textual content's motivating capability on people's exercise motivation.

First, we surveyed people about their perceptions of how motivational text messages support their exercise motivation. Second, we explored how perceived motivational capability influences exercise motivation and enjoyment. Third, the researchers explored how encouraging text messages following a micro-theory of Self-Determination Theory—the cognitive evaluation theory—with applied personalized aesthetics impact the immediate assessment of how motivating a message is and individuals' exercise motivation over time.

Lastly, and as a final step in this third stage, the researchers conducted a pilot study to explore the impact of aesthetic pleasure on participants' exercise behavior.

1.2 Thesis Statement and Research Questions

This research explored how aesthetic pleasure impacts motivational text messages' power. Accordingly, we explored the following research questions in the context of physical exercise:

RQ1: How does aesthetic pleasure impact the motivational capability of encouraging text messages?

RQ1.1. Does positive aesthetic pleasure make the text messages more motivating?

RQ1.2. Does negative aesthetic pleasure make the text messages less motivating?

RQ1.3. Does the frame of the text messages influence the power of their aesthetic pleasure?

RQ2: Subsequently, how does a text message's perceived motivational capability influence exercise motivation and enjoyment?

1.3 Research Design and Limitations

We started this research by exploring people's motivations to look for motivational text messages on digital platforms (social media, activity trackers) and identifying differences in needs between those who see motivational text messages and exercise regularly and those who do not.

Second, we conducted a quasi-experiment. We collected a list of text messages used in commercial activity tracker services, embedded them in visual presentations, and measured differences between exercise motivation in those who had perceived the visual presentation as beautiful, neutral, and ugly.

Third, we conducted three quasi-experiments exploring different text message content structures (positive versus negative frame, self-liberating messages, perceived competence) and, similar to what we did in our first quasi-experiment, measured the impact of aesthetic pleasure on the perception how motivating a message was. Further, we measured differences between exercise motivation in those who had perceived the visual presentation as beautiful, neutral, and ugly.

Finally, we conducted an exploratory study that exposed people to motivational text messages over four weeks and measured the evolution of their exercise motivation over time.

Due to the nature of studying the effects of perception, subjects were not randomly assigned to the conditions. In other words, we conducted quasi-experiments and not true experiments. This means that subjects were not randomly assigned to the conditions. Therefore, the results presented

cannot claim a relation of cause and effect between variables. They can claim only an association because we cannot guarantee a potential equivalence between the groups of each condition.

All studies were conducted using online crowdsourcing platforms—Amazon Mechanical Turk and Prolific.co—and all participants were compensated for participating in the studies. The results presented may be biased by each platform's user profiles, although the researchers took care to recruit people within the studies' target audience. Moreover, the results may not represent the results found in a more natural context. Other variables may also interact with the effect of aesthetics and encouraging text messages on exercise motivation.

Chapters 3 and 4 present all studies conducted. Chapter 3 presents the initial survey results to explore the motivations for looking for motivational text messages and the quasi-experiment in which text messages came from industry examples (they were not classified). Chapter 4 presents the three quasi-experiments in which messages were classified following several frameworks.

Ultimately, all studies (quasi-experiments) provide us with direct insights to an answer to all research questions.

Because we did not randomly assign the subjects to the conditions and thus apply a true experiment, the results presented cannot claim a relation of cause and effect between variables; they can claim only an association.

All studies were conducted using online crowdsourcing platforms—Amazon Mechanical Turk and Prolific.co—and all participants were compensated to participate in the studies. The results presented may be biased by the user profiles of each platform, although the researchers took care to recruit people within the studies' target audience. Moreover, the results may not represent the results found in a more natural context, in which other variables may also interact with the effect of aesthetics and encouraging text messages on exercise motivation.

Each study was constructed over a previous one, meaning that limitations in the design of one study were overtaken in the next study—for example, applying theoretical frameworks in the classification of text messages.

1.4 Contributions

This research project contributes to the following:

- A list of 30 encouraging text messages for doing physical exercise classified by perceived competence that can potentially be used as support in visual quotes studies related to the visual aesthetics of text.

- Expansion of the literature on human-computer interaction concerning how perceived beauty impacts the general impression or attributes of a product (e.g., its behavior change potential).
- A semi-automated process to create a visual text presentation (a visual quote) that aims to match each user's visual aesthetic preferences, based on the choice of typographic attributes
- Four quasi-experimental studies of how perceived beauty from visual quotes may influence the motivating capability of encouraging text messages with distinct framing styles;

1.5 Publications

Results of our studies were published in the following peer-reviewed international conferences: Persuasive Technology 2017, CHI 2018, CHI 2019, CHITALY 2019, TIEE 2019, and ECCE 2019.

Lígia Duro, Evangelos Karapanos, Teresa Romão, Pedro Campos. 2017. Does Beauty Matter in Behavior Change? In *Adjunct Proceedings of the 2017 International Conference on Persuasive Technology (PERSUASIVE 2017)*. Amsterdam, The Netherlands. Winner of the Best Poster Award.

Lígia Duro. 2018. Why Should Your Activity Tracker Care About How Motivational Messages Look Like to You. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (*CHI EA '18*). Association for Computing Machinery, New York, NY, USA, Paper SRC06, 1–6. DOI:https://doi.org/10.1145/3170427.3180285

Lígia Duro, Pedro F. Campos, Teresa Romão, and Evangelos Karapanos. 2019. Visual Quotes: Does Aesthetic Appeal Influence How Perceived Motivating Text Messages Impact Short-Term Exercise Motivation? In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (*CHI EA '19*). Association for Computing Machinery, New York, NY, USA, Paper LBW0139, 1–6. DOI:https://doi.org/10.1145/3290607.3312830

Lígia Duro, Pedro F. Campos, Teresa Romão, and Evangelos Karapanos. 2019. How do motivational text messages impact motivation to exercise? implications for the design of activity trackers. In *Proceedings of the 13th Biannual Conference of the Italian SIGCHI Chapter:*

Designing the next interaction (*CHItaly '19*). Association for Computing Machinery, New York, NY, USA, Article 10, 1–10. DOI:https://doi.org/10.1145/3351995.3352043

Lígia Duro, Teresa Romão, Evangelos Karapanos, Pedro Campos, and Pedro Campos. 2019. How does the visual aesthetics of positively-framed messages impact their motivational capacity? *Proceedings of the 31st European Conference on Cognitive Ergonomics*. Association for Computing Machinery, New York, NY, USA, 162–167. DOI:https://doi.org/10.1145/3335082.3335085

Lígia Duro, Evangelos Karapanos, Pedro Campos, Teresa Romão. 2020. Visual quotes and physical activity tracking: Can aesthetic pleasure motivate our short-term exercise motivation? *Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST, volume 307*. 109–118. DOI: https://doi.org/10.1007/978-3-030-40180-1_12

2

Literature Review

This chapter provides a theoretical background on this thesis. First, it offers an overview of what emotional design is and how positive emotions from artifacts improve user connection. Then we move on to aesthetic pleasure, several definitions found in the literature, how the role of aesthetics has evolved over the years in the field of human-computer interaction, and the effect of perceived beauty in usability and task performance. Next, we describe what visual quotes are and provide some research findings related to their mental health influence. Lastly, we describe the main findings of the cognitive evaluation theory, a micro-theory of self-determination theory that focuses on the effects of feedback and other external events on intrinsic motivation.

2.1 Design and Emotion

In today's competitive environment, as the age of a category of products increases, product differentiation becomes difficult because products are similar with respect to their technical characteristics, quality, and price. When the functional quality of a product increases, usability and aesthetics take on greater importance [12, 42, 62]. Accordingly, as the computer industry and the technology matured, usability and desirability became important perceived differentiators in human-computer interaction.

In 1990, Don Norman claimed the primacy of functionality over other user experience dimensions [116]. In 2004 [117], the author asserted that, after all, the emotional side of a product’s design may be more critical to that product's success than other, more practical dimensions (namely, functionality). Fundamentally, Norman suggested that emotion matters because much of human behavior is subconscious and triggered by emotions.

This point of view aligns with the most up-to-date neuroscience research. Emotions give meaning to things and situations and help us make decisions. Individuals with injuries to the areas of the brain responsible for emotion cannot decide when to schedule a doctor's appointment or which restaurant to choose for lunch [29]. Elicited emotions are like a layer that paints reality (facts), providing us with vital information for the decision-making process. People tend to make decisions irrationally based on how they feel (or how they anticipate they will feel) and not the opposite [28, 29].

Outside the field of research, for Aarron Walter [170], designers are "in a unique position to help users follow their gut instincts. Using common design tools like layout, color, line, typography, and contrast, [they] can help people more easily consume information and make a decision driven by instinct more than reason. Just as [we] chose the shirt [we're] wearing because it felt right, [designers] can help [their] audience sign up for a service or complete a task because their gut tells them it's the right thing to do. Remember, [designers] don't have to make an exhaustive case for action because reason is not often the primary driving force [their] audience uses to decide. [Designers] just have to appeal to [audience] emotions to make the benefits appear to outweigh the costs."

Focusing back on research, Demir [41] classifies the many emotional concepts found in the field of design and emotion into three categories: emotional responses, emotional experiences, and emotional relationships. The three can relate to each other within a hierarchical structure (Figure 2.1), "where the single emotional moments may accumulate into an experience, and where the accumulation of those experiences yield an emotional relationship."

Figure 2.1: Emotional concepts in the field of design and emotion. Adapted from Demir [41].

From a psychology perspective, emotions are subjective affective experiences and several discrete emotions can be identified, such as happiness and fascination [41, 59].

2.1.1 Emotional Design Models

Liz Sanders [137] summarized the different facets of users' emotional needs related to a product into three categories: desirability, usability, and usefulness. Table 2.1 (adapted from Gorp [62]) shows how product elements address the different facets of users' emotional needs. Aesthetics, i.e., how the product looks and feels, is linked to desirability (aesthetic appeal). The interaction, i.e., how the user interacts with the product, is related to usability (the capacity to be understood, learned, and utilized). Functionality, i.e., what the product does, relates to usefulness (to accomplish what it was designed to do).

Gorp [62] explains that "if the product doesn't *function* as promised, it has very little usefulness, so a relationship is not likely to form. If the product is difficult to *interact* with and unreliable, it's not usable, so any experience the user has will be negative. Finally, if the *aesthetics* of the product are not attractive and appealing to the users' senses, they likely won't find it desirable either."

Table 2.1: How the dimension of Sanders' design goals model relates to product elements. Adapted from Gorp [62].

Product Elements	**Aesthetics** How the product looks and feels ↓	**Interaction** How the user interacts with the product ↓	**Function** What the product does ↓
Sanders, 1992 [137] Design Goals	**Desirable** Aesthetically appealing	**Usable** Capacity to be understood, learned & utilized	**Useful** Accomplishes what it was designed for

2.1.1.1 Levels of Emotional Processing

Norman's (2004) [117] model focuses on levels of emotional processing. According to the author's framework, affect may arise due to three levels differing in cognitive involvement.

The "visceral level" embodies the sensory aspects of how things look, feel, smell, and sound, and elicits immediate involuntary and subconscious responses. Here are the most 'automatic' affective responses (unconscious judgments).

The "behavioral level" represents the affect from the product's use (interaction), such as satisfactory completion of a task. In its essence, it is about the experience of using a product to fulfill needs. Both usability and performance are at the main core of this level.

The "reflective level" focuses primarily on products' personal and cultural meanings, such as a sense of identity through the product's consumption over time. In this sense, as opposed to the other two levels, which function fundamentally in the present, the reflective level extends over time to process self-image and identity [62, 117].

2.1.1.2 Products as Objects, Agents, and Events

Desmet's (2002) [43] model suggests a framework for discussing how products can operate as emotional stimuli. The model distinguishes between products as objects, agents, and events, and is based on the types of appraisals that users make when forming judgments about products. The result of appraisals is likely to depend on the product's relevancy to each user's personal concerns and their product focuses. That is because people differ in their concerns; they may differ in their emotional responses. The framework distinguishes three forms of products able to elicit emotions: as an object, as an agent, and as an event. Because products can be construed as relevant for more than one concern, they can simultaneously elicit more than one emotion.

Products as Objects

A way to experience products is to look at them as objects or artifacts. In this sense, their overall visual appearance or some particular detail or feature (e.g., the shape, texture, color) can elicit emotions. "When our attention is attracted to a product as an object, we are mainly concerned with how aesthetically appealing it is. When the aesthetics match our attitudes around what is appealing, we feel pleasure and attraction. Emotional responses like this include positive results like love, negative results like disgust and neutral results like indifference" [43].

Products as Agents

Although they are inanimate objects, products act as agents when they cause or contribute to events. For example, "products are often blamed when their quality or functioning does not live up to our expectations. These expectations can be based on the product's appearance, price, packaging, etcetera. (...) [Moreover], products can also be treated as agents with respect to the presumed impact they generally have or may have on people or society" (e.g., a gun) [43].

Products as Events

The relationship that users have with a product as an event is related to anticipated and past consequences. When users judge how well a product helps them realize their future goals, the anticipation of the benefits of owning the product may produce an emotional response. For example, " Owning an expensive car might be perceived as conveying the benefits of higher status to the owner. The anticipation of positive benefits can also make the product more desirable" [43, 62].

Similarly, remembering the consequences of past interactions with a product may evoke positive or negative emotions. "For example, seeing our old teddy bear can remind us that the untroubled days of our childhood have gone. The bear, symbolising the event of growing up and losing our childhood, can make us sigh with melancholy. The trophy we once won can fill us with joy because it reminds us of a celebrated victory" [43].

2.1.1.3 Types of User Benefits

Based on different theories stemming from anthropology, Jordan's model (2000) [86] discusses positive affect generated in user-product relationships. The framework identifies three different types of benefits that products provide to users.

Hedonic Benefits

These are the result of sensory and aesthetic pleasures people experience when interacting with a product. "This can involve the appreciation of an object for its aesthetic considerations, or the enjoyment of the tactile qualities associated with handling a product" [62].

Practical Benefits

These result from accomplishing a task with a product.

Emotional Benefits

These are understood as longer-term benefits that arise from the relationship with the product.

2.1.1.4 Touchpoints Between the Three Models

Each model indicated above describes a similar phenomenon from a slightly different perspective. All the models focus on emotional processing from a "first impression" that comes mainly from products' aesthetics or formal properties. These emotional reactions occur instantaneously and unconsciously. When an individual perceives a product as aesthetically appealing, it is foreseen that he/she will feel attracted to it.

All categories of each model are related mainly to specific product elements (dimensions). Table 2.2, adapted from Gorp [62], shows the relationships between both factors. Using Norman's model (Levels of Processing) as an example, the visceral level is related to the initial impression of a product; this is related to how the product looks and feels and, therefore, its aesthetic and tactile qualities. The behavioral level already implies some interaction with the product; here are the emotions from effectiveness (accomplishing a task) and ease of use. The third processing level, the reflective, implies a more extended use of the product and is related to how the product does what it does. Therefore, it accounts for personal satisfaction and memories.

Table 2.2: How the categories of emotional design models relate to product elements. Adapted from Gorp [62].

	PRODUCT ELEMENTS		
	Aesthetics How the product looks and feels	**Interaction** How the user interacts with the product	**Function** What the product does
MODELS			
Levels of Processing Norman 2004	**Visceral** Aesthetic and tactile qualities	**Behavioral** Effectiveness and ease of use	**Reflective** Self-image, personal satisfaction, memories
Products as Objects, Agents and Events Desmet 2002	**Objects** Does it appeal to my attitudes?	**Agents** Does it meet my standards?	**Events** Does it help reach my goals?
Types of Benefits Jordan 2000	**Hedonic Benefits** Sensory and aesthetic pleasures	**Practical Benefits** Result from the completion of tasks	**Emotional Benefits** Effects on user's emotions

2.2 Aesthetic Pleasure

The word ‘aesthetics’ derives from the Greek word ‘aisthētikos,’ meaning ‘relating to perception by the senses.’ This early form of the word was a combination of two Greek words: ‘aisthēta,’ meaning ‘perceptible things,’ and ‘aisthesthai,’ meaning ‘perceive.’ The general definition of aesthetics as we know it today—referring to the appearance of something, particularly concerning its beauty—was coined in German in the mid-18th century and was adopted into English in the early 19th century [3].

In philosophy, Immanuel Kant was one of the most influential early theorists studying aesthetics (the experience of beauty) (towards the end of the eighteenth century). Kant's theory of pure beauty has four distinguishing features: 1) the disinterest of the spectator, 2) universal, 3) necessary, 4) freedom from purpose [63, 87]. Douglas Burnham explains [16] that following Kant's theory, aesthetic judgments are (1) disinterested, i.e., "we take pleasure in something because we judge it beautiful, rather than judging it beautiful because we find it pleasurable." Aesthetic judgments are also (2) universal and (3) necessary. Douglas explains [16] that although it may be said that beauty is in the eye of the beholder, an intrinsic part of aesthetic judgments is to expect others to agree with us—"just 'as if' beauty were a real property of the object judged." For example, "If I judge a certain landscape to be beautiful then, although I may be perfectly aware that all kinds of other factors might enter in to mak[ing] particular people, in fact, disagree with me, never-the-less I at least implicitly demand universality in the name of taste." We debate and argue over our aesthetic judgments, believing that such debates can actually achieve something. "Indeed, for many purposes, 'beauty' behaves as if it were a real property of an object, like its weight or chemical composition." But Kant insists that universality and necessity are a product of features of the human mind. There is no objective property of a thing that makes it beautiful. Fourth, aesthetic judgments are free from their purpose because they are an end in themselves. Douglas [16] explains that beautiful objects appear to be 'purposive without purpose.' An object's purpose is the concept according to which it was made. Kant argues that it is part of the experience of beautiful objects, that they should affect us as if they had a purpose, although no particular purpose can be found.

2.2.1 The Term ‘Aesthetics’ in HCI

For a long time, HCI empirical research was focused predominantly on pragmatic qualities of interactive systems such as utility or usability [114]. Around the early 2000s, non-instrumental qualities (task-unrelated attributes), such as beauty, aesthetics, affective and emotional reactions,

and the joy of use were introduced to the design and evaluation of interactive systems [7, 128]. As Thielsch et al. [152] argue, non-instrumental qualities stopped being seen as a ‘nice-to-have’ facet and evolved into a ‘must-have’ facet. Therefore, several user experience frameworks began to incorporate these kinds of attributes—e.g., AttrakDiff [73], Desmet, and Hekkert’s framework of product experience [44], the CUE-Model [153]. “Today, besides usability, non-instrumental qualities are considered constituent parts of an enriched model of product quality supposed to affect product appeal and user experience during system usage ‘beyond the instrumental’ including affective and emotional reactions” [67].

A 2019 HCI article by Thielsch, Haines and Flacke [152] highlights that nowadays the term ‘aesthetics’ is known as a multi-dimensional construct in the field, yet lacks a ubiquitous definition. There are different tendencies in HCI research in defining aesthetics. For instance, Lavie and Tractinsky (2004) [96] differentiate between ‘classical’ and ‘expressive’ aesthetics. ‘Classical’ aesthetics includes attributes like ‘clean,’ ‘pleasant,’ and symmetrical,’ whereas ‘expressive’ aesthetics is meant to be ‘sophisticated’ and ‘creative.’ Moshagen and Thielsch (2010) [107] specify aesthetics as being an “immediate pleasurable subjective experience that is directed toward an object and not mediated by intervening reasoning.”

Reber, Schwarz, and Winkielman [126] distinguish three main positions in defining beauty. First, an *'objectivist view'* sees "beauty as a property of an object that produces a pleasurable experience in any suitable perceiver" [126, 149]. This main position has inspired many psychological efforts to identify contributors to beauty. Examples are balance and proportion [5, 10], symmetry [5, 10], and contrast and clarity [142]. Next, is a *'subjectivist view'* in which anything could be beautiful if it pleases the senses [169]. Beauty regarded as "a function of idiosyncratic qualities of the perceiver and all efforts to identify the laws of beauty are futile." This view reflects the expression "beauty is in the eye of the beholder." Finally, beauty is seen from an *'interactionist view'* that follows most modern philosophical analyses, which reject the objective versus subjective view. From this position, "a sense of beauty emerges from patterns in the way people and objects relate" [80, 126]. "Beauty is grounded in the processing experiences of the perceiver that emerge from the interaction of stimulus properties and perceivers' cognitive and affective processes" [126].

Finally, in this thesis, we adopted Dutton's [11, 52] definition of aesthetic pleasure: 'the pleasure people derive from processing the object for its own sake, as a source of immediate experiential pleasure in itself, and not essentially for its utility in producing something else that is either useful or pleasurable."

2.2.2 How Perceived Beauty Influences Other User Experience Dimensions

The establishment of aesthetics (the beauty or pleasing appearance of an interactive system) in human-computer interaction, as a non-instrumental quality of interactive systems, started raising questions about the interplay between instrumental and non-instrumental qualities [67], for example, on the interplay between aesthetics and usability. Usability is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [1].

The seminal studies of Tractinsky and colleagues [93, 154] tested the relationships between users' perceptions of beauty and the usability of a computerized application as a surrogate for an Automated Teller Machine. The results indicated strong correlations between the system's perceived aesthetics and perceived usability in pre- and post-experimental measures. The ATM layout's manipulated aesthetics were the only determinant affecting the post-use perceptions of both perceived aesthetics and perceived usability. That is to say, they found a direct influence of a system's aesthetics on perceived usability. This relation of "What is beautiful is usable" is believed to resemble the "What is beautiful is good" stereotype in social psychology [71, 156]. People tend to think "that a person's beauty is positively related to social competence, adjustment, potency, intellectual competence, and general 'goodness'" [45, 71]. Similarly, HCI researchers assumed that an interactive product perceived as beautiful might also indicate increased usability.

Other studies support this possibility of aesthetics influencing perceived usability. Ben-Bassat and colleagues [8] manipulated the usability and aesthetics of a data-entry application. The system's aesthetics affected evaluations of usability as well as aesthetics. The high-aesthetics version of the system was perceived as slightly more usable than the low aesthetics version. Furthermore, the system's usability affected evaluations of both usability and aesthetics. Sonderegger and Sauer [144] found that a mobile phone skin's manipulated visual appearance had a positive effect on its perceived usability. Lee and Koubek [98] created four versions of a website and examined the relationship between usability and aesthetics. Before the system's actual use, user preference was significantly affected by aesthetics but not for usability. After use, user preference was influenced by both aesthetics and usability.

In contrast, Tuch et al. [158] and Thüring and Mahlke [153] found no support for the "What is beautiful is usable" hypothesis. The findings of an experiment by Thuc et al. [158], who manipulated four different versions of an online shop interface with different levels of aesthetics and usability, revealed that aesthetics does not affect perceived usability. In contrast, usability enhances post-use perceived aesthetics. Similarly, Thüring and Mahlke [153] conducted three

experiments that manipulated a portable digital player's aesthetics and usability. The researchers did not find an effect of manipulated aesthetics on the perceived usability or of manipulated usability on perceived aesthetics in any experiment.

Hassenzahl and Monk [72] analyzed fifteen studies with mixed results regarding the interplay between aesthetics and usability. Most of the studies were correlational, and could not prove causal relationships. Coefficients ranged from .00 to .92, which shows a considerable variation in the obtained correlations. The authors suggest that this variability may be explained in part by inconsistencies in the methods and analysis and in how beauty is operationalized. Hassenzahl [70] distinguished between three general approaches to operationalizing 'beauty': normative, judgmental, and experiential.

A normative approach attempts to provide a “recipe” for how to design something beautiful. Studies following this approach focus on how the variation in the properties of visual design elements (e.g., variation in width, style, and weight of typefaces) influences the human perception of beauty. As such, this approach might assume that symmetry is more beautiful than asymmetry, particular proportions are better than others, and so forth. *Judgmental approaches* are concerned with what users judge to be beautiful or not. They are interested mainly in the consistency of beauty judgments among individuals and how fast and easy these judgments are. In addition, they address the question of how beauty relates to other product attributes, such as novelty or usability. Finally, the *experiential approaches* focus on all-embracing holistic experiences characterized by an individual’s altered perception of their surroundings. They tend to preserve the complexity and richness of an aesthetic experience, in the sense that they do not look for ways to explain which specific characteristics of the object cause an object to be perceived as beautiful or not. Rather, they focus on how changes in the perception of beauty impact the assessment of artifacts. Further, the authors argue that beauty may play an influential role in first impressions of products, as it is one of the most immediately available qualities. The relationship between aesthetics and usability was found to be wholly mediated by goodness [72].

Suggestions for further research are given by Hassenzahl and Monk [72], as well as by Van Schaik et al. [139]. First, Hassenzahl and Monk [72] suggested more experimental studies testing causal models of the interplay between instrumental and non-instrumental qualities on the perception of a system's quality. Van Schaik et al. [67, 139] proposed "find evidence for the different inference rules and suggested experimental manipulations, for example, of design characteristics that contribute to the "objective" usability of a product."

Regarding the effect of perceived beauty on task performance Thielsch, Hanies and Flacke [152] noted that, as in the case of the influence of visual aesthetics in usability, the handful of

studies examining whether visual aesthetics might influence task performance has produced mixed support for this notion. Some studies have found a positive effect of visual aesthetics in increasing performance efficiency. Others have found that aesthetics have negative effects on performance. Still others found no effect of visual stimulus on task performance.

Following are examples of studies suggesting that aesthetic interfaces could enhance performance. Douneva, Jaron, and Thielsch [46] (2016) used different types of company website designs to investigate the importance of first impressions of a site's appearance on memory performance. Participants were randomly assigned to one of the websites in an embedded frame for five seconds. Next, they had to complete five memory tasks related to the website. Three of these tasks were related to memory performance (name of the company, locate the position of the logo and locate the position of the navigation area/bar). Memory performance was better on SAPAT sites (that had the same amount of pictures and text) than on SCOFA (strong colors of one color family) and LAPIC (large pictures) sites.

Moshagen, Musch, and Göritz [106] (2009) manipulated the visual aesthetics of a website providing health-related information to investigate whether the effect of visual aesthetics would affect task performance. Each participant was randomly assigned to one of the four versions of the websites that varied regarding visual aesthetics (high vs. low) and usability (good vs. poor). Task completion times and error rates were used as performance measures. A significant interaction between visual aesthetics and usability revealed that high aesthetics enhanced performance under poor usability conditions.

In the field of e-learning, Miller [104] (2011) manipulated two aesthetic design configurations of an e-assessment environment to examine the impacts of aesthetic design on learners' experience. One of the environments was defined as having low consideration of aesthetic design. This first environment was designed to provide the utility and usability necessary to complete the tasks. A second environment took into consideration the utility and usability in terms of performing the task objectives and was designed with several aesthetic enhancements to heighten the learner experience. The quantitative and qualitative data analysis suggested that aesthetic design decreases participant cognitive load and increases participant satisfaction, willingness to continue use, voluntary self-assessment time, and task performance.

In contrast, some studies suggest that aesthetics has a negative effect on performance. Sonderegger and colleagues [143] conducted an experimental study that manipulated the aesthetic appeal (high vs. low) of a cell phone and its usage domain (work vs. leisure). Participants were asked to complete a series of typical cell phone user tasks. While aesthetic appeal had a positive effect on perceived usability, it produced a negative impact on performance. Schaik and Ling

[140] manipulated webpages' aesthetics and found that perceived aesthetics are not correlated with measures of task performance. In addition, Sauer and Sonderegger [138] studied the influence of the aesthetics of mobile phones in user performance and found that increased product aesthetics led to longer task completion times.

Lastly, other studies found no effect of aesthetics on task performance. For example, Hartmann and colleagues [69] (2007) investigated the influence of attractiveness in web user interfaces. The results indicated that there were no performance differences in task completion times between each aesthetic condition. Thielsch, Haines, and Flacke [152] (2019) manipulated the interface aesthetics of a website related to medical information online to investigate the effects of website aesthetics on different virtual tasks. The results showed that aesthetics had no significant effects of aesthetics on task performance (accuracy and response times).

A 2019 paper [152] highlights that studies investigating the relationship between aesthetics and other variables are typically non-based theory-driven and no model explains the observed findings. “Most of the studies on the topic are based on students’ samples and explaining models are often discussed post-hoc, whereas field studies, theory-driven experiments, systematic overviews or meta-analyses are lacking.” Nonetheless, some prominent theories are used to explain the positive effect of aesthetics on other products' factors:

1. The halo effect stereotype.
2. The 'positive affect mediation' hypothesis.
3. The 'increased motivation' hypothesis.

The halo effect is a type of cognitive bias in which our overall impression of a person influences our evaluation of that person's specific traits [69, 146]. In other words, people have a habitual tendency to rate attractive individuals more favorably for their personality traits or characteristics (e.g., kindness, intelligence, technical skill, performance) than those who are less attractive. In HCI, a similar effect has been found and is known as the 'what is beautiful is usable' principle [156]. Products rated as more attractive are more likely to be assessed as more usable.

Regarding the 'positive affect mediation' hypothesis, according to Norman [115, 117], an attractive interface might evoke positive affect, which in turn is used as an input to judgments of beauty and general liking. It may be that because individuals feel more positive when they perceive a product as beautiful, they recognize other attributes of the product as more favorable.

Lastly, according to Sonderegger and Sauer (2010) [144], the 'increased motivation hypothesis' proposes that an attractive interface may motivate and put users at ease and, thus, increase the assessment of other attributes of the products.

To sum up, as suggested by Hamborg and colleagues [117], the "effects of aesthetics and of usability on hedonic experience in terms of endowing identity and appeal were found, indicating that both instrumental (usability) and noninstrumental (beauty) qualities contribute to a positive user experience."

How aesthetics might influence other products' qualities is not yet clear, being that the 'positive affect mediation' hypothesis from Norman is the one that more authors seem to post-hoc favor. On the other hand, multiple studies found evidence of a negative effect of aesthetics in other product qualities, such as usability and performance outcomes, while other studies found no effects. The present contradictory results present in the literature make unclear the 'real' impact that perceived aesthetics (beauty) might have on other products' qualities.

2.3 Visual Quotes

The advent of social media, such as Facebook, has enabled an unprecedented level of text message sharing [9, 112]. In 2011, one in nine social media users shared health-promoting messages [112, 136]. Nowadays, many individuals look for motivation or support to become more regularly physically active in social media and other mHealth technologies (platforms) [84, 97, 100, 151]. Types of mHealth technologies include smartphone devices, internet-delivered education and interventions (including online social media and communities), smartphone or tablet applications, wearable devices, and activity trackers [18]. For example, individuals seek social support in social media platforms [84, 151], which "encompasses the provision of material resources, useful information, emotional care, and affirmative feedback" to promote health maintenance attitudes and behaviors [84, 94].

This sharing of text messages is accompanied by a digital social trend of sharing online text messages embedded in visual presentations—in other words, as visual quotes. This phenomenon had certainly caused even big digital industry players to add related features in their products. For example, Facebook, the largest social media network, announced in 2016 a new feature in its platform that lets users add a background color to text posts [55]. That same year, the multinational software company Adobe Inc. launched Adobe Spark Post, an online and mobile app that helps people create visual quotes (text messages embedded in a visual layout) with pre-defined visual templates [2]. Users can manipulate the properties of visual design elements (e.g., font size, font color, text position, layout), which helps personalize the visual presentations

according to users' preferences in terms of visual aesthetics. Lastly, we can spot this trend in commercial activity tracker services, such as Nike Run Club, which allows users to mix workout photos with text messages and share them on their social media networks.

The text designs of many online visual quotes seek to accomplish a dual goal: to call attention to themselves (work as display text) and somehow be easy to read (work as body text). This double goal distinguishes them from (only) body-text [13] designs, whose purpose is primarily to provide legibility and readability.

Often, exercise-related posts on social media are a mix between image (a photo) and text content. One popular exercise-related metadata tag on social media is #fitspiration. Smith et al. [40] reported that in June 2016, more than 7.8 million publicly available images were posted on Instagram using this hashtag. One of the predominant characteristics of content shared on social media platforms containing hashtags, such as #fitspirational, #fitspiration, or #fitspo is the showing of gendered body image ideals and individuals presented in sexually objectified ways, with physical exercise positioned as a means of achieving these ideals [20, 40]. The issue is that these appearance-focused media representations of exercise may be problematic [60]. This builds upon the existing media effects literature; this type of image post can have negative psychological consequences such as weight-related appearance anxiety, a negative mood, and body dissatisfaction [68].

This research project explored on exploring how typographic text-compositions (no use of photos or images as background) may impact individuals' exercise motivation. The goal was to understand whether perceived beauty from the text messages' visual presentation may positively influence this type of text message's motivating power in terms of exercise motivation.

Inspired by studies from multimedia learning [74, 159], which have used visual design elements to foster intrinsic motivation to facilitate learning processes (through arising positive emotions [74, 159]), this research project explored whether aesthetics can strengthen text messages' effect on exercise motivation.

2.4 mHealth Text Messages

Following Borrelli (2015) [14], “mHealth refers to mobile and wireless applications, including text messaging apps, wearable devices, remote sensing, and the use of social media such as Facebook and Twitter, in the delivery of health-related services”. With respect to the term “eHealth” (electronic health), the two areas [14] “encompass the preponderance of growth and tend to be used as the umbrella terms for the explosion of research currently being conducted at the intersection of technology and health psychology.”

The main benefits of eHealth/mHealth interventions are: cost-effective delivery, availability (anywhere), accessibility (anytime), scalability, tailored content, the ability to provide real-time strategies to users in their everyday settings, and the capacity to calibrate the intervention intensity to the user's needs [14, 88]. Text messaging for health can be considered part of the broader strategy of mHealth.

Text message-based health interventions can provide individuals with, for example, reminders, information, or self-management assistance. A systematic review of reviews (2015) that evaluated SMS/MMS interventions either as stand-alone programs or combined with other intervention strategies (e.g., journaling) in adults [66] found that most published (mobile) text-messaging interventions were effective when addressing physical activity (i.e., had a small positive effect). However, authors found limited evidence to determine the most efficient intervention characteristics and suggest that additional research is needed to establish longer-term intervention effects, identify recommended features (i.e., message frequency, personalization and tailoring of messages, interactivity), and explore issues of cost-effectiveness. Other systematic reviews [15, 53, 147] uncovered similar results: Text messaging can have a beneficial impact on the reduction of physical inactivity; however, more rigorous trials are needed to determine which parts of the intervention or technology are effective.

One of the seven main uses of social media for health communication is facilitating, sharing, and obtaining health messages [105]. However, social media-based interventions that focused exclusively on using text messages, text posts, or text messaging were difficult to find. Social media-based exercise interventions typically combine multiple strategies such as motivational messaging, health education information, and peer interaction into a single treatment [21, 113]. This scenario made it impracticable to identify the causal effects of motivational text messages on the exercise motivation of social media users.

Regarding the development of the content for motivational text messages, in the context of physical activity, researchers have been exploring several factors, with the ultimate goal of having a better chance of stimulating behavioral change—for instance, gain- versus loss-framed messages [162]; messages tailored to personality [166], gender [166], and behavior change stages [167]; self-efficacy levels [95]; differences in the motivational capability of text messages created by experts and peers [168]; and source credibility [85]. All in all, these studies show that several factors can influence the efficiency of motivational text messages in increasing exercise motivation. Gain-framed messages (focused on the gains of engaging in healthy behavior) can result in stronger intentions to be physically active than loss-framed messages (focused on the losses associated with unhealthy behavior) [162]. Messages are perceived as being more or less

motivating depending on personality traits such as openness, extraversion, and agreeableness. Gender also plays a role in how motivational text messages are perceived [166]. Motivational text messages are perceived as being more motivating when individuals are in the later stages of change [167], and can impact individuals' beliefs related to their ability to achieve their exercise goals (self-efficacy) [95]. Expert-designed messages are more motivating to individuals in the earliest behavioral change stages, while peer-designed messages are perceived as being more motivating to individuals who are in the later behavioral change stages [168]. Positive-framed messages from a credible source can help to positively influence exercise intentions [85].

The impact of textual feedback in the context of physical activity tracking has received relatively limited attention [27, 64, 111]. Gouveia and colleagues [64] developed an activity tracker application that showed text messages to users based on their present and past activity levels. The textual feedback was designed to support either reflection or persuasion. Messages to support reflection were designed to assist users in gaining better knowledge about their behaviors avoiding employing any form of recommendation or nudging—for example, "*You are the second most active person at work.*" Persuasive messages, on the other hand, were designed to instigate behavior change by providing explicit recommendations—for example, "*Last week, you reached your daily walking goal 2 times, try updating it to 8km.*" The authors concluded that while persuasive messages led to greater time until re-engagement with activity trackers, users would take less time to start walking and walk for long distances. Following the authors, these findings support previous research: While persuasive messages tend to instigate action in the short-term, aversion and reactance also arise, potentially constraining long-term engagement. Another factor that the authors evaluated was the novelty as opposed to the familiarity of the messages. Novel messages led users to return to the application in a shorter period of time as compared to familiar messages. However, no differences were found in terms of inspiring users to walk more. While novel content helped intensify engagement with the tracker per se, this did not directly translate into a change in exercise behavior.

In a previous article, in 2014, Consolvo et al. [27] highlighted some of the advantages of using textual feedback to present data findings, indicating, as the strongest point of textual feedback, the fact that it can "provide people with information about their data that they might not have discovered themselves" and highlighting that, by providing feedback in everyday language, "textual feedback can also overcome the problem of giving self-monitoring feedback to users with low numeracy." Some of the advantages of using textual feedback were also noted by Villalonga and colleagues [164] in a 2017 paper in which they presented an ontology-based approach to model personalizable motivational messages for promoting healthy physical activity.

Their proposed ontology models the message intention and its components (e.g., argument, feedback, or followup, as well as its content, such as action, place, time, action, or object required to perform the recommended activity). The goal was to find the "appropriate feedback using context information to prune irrelevant branches of the ontology." Following the authors, this model differs from others in the fact that most of these models include information only about the structure of the message or its intention.

Researchers also have been exploring text messages as a way to remind users of their plans [78, 125]. Reminding users about their exercise goals through the internet or mobile phone can help them increase their physical activity [78, 125]. The findings suggest that a combined implementation intention with text message reminders is more effective than either strategy alone in terms of increasing exercise [125]. However, pairing implementation intentions with SMS was beneficial only when a participant chose to receive reminders of their plans, which implies that reminding an individual of their plans drives the effects. This effect might happen, as the authors explain, because "the intervention should increase the accessibility of the environmental cue (as the individual is reminded of this cue) or cue an individual to implement their plan (as the individual is reminded of the association between the cue and their desired action), or both" [125]. However, the authors did not directly test these processes and additional explanations should be considered.

Lastly, recent early-stage work [157] found that motivational text messages can increase physical activity levels, likely due to their impact on the type of motivation linked to the initial adoption of exercise [150] (on extrinsic identified behavior regulation). Tseng and colleagues [157] developed a mobile application to deliver motivational text messages to adult office workers with sedentary jobs. They also provided monetary incentives to foster walking behavior. The creation of the motivational text messages was not detailed, although according to the participants, these messages reminded them to engage in physical activity. This early work found that motivational text messages can improve people's walking behavior only when their behavior is first influenced by motivational text messages, and not through money.

Participants who received the motivational text messages first, and then the monetary reward, increased their identified behavior regulation levels after exposure to the motivational text message intervention. The extrinsic identified behavior regulation, in turn, has been linked to the initial adoption or short-term exercise adoption [150]. Motivational text messages seem to be able to impact this critical type of motivation to start exercising.

2.5 Self-Determination Theory: The Micro Cognitive Evaluation Theory

Self-determination theory (SDT) is an empirically based macro-theory of human motivation [39, 133], which includes several mini-theories, one of which is cognitive evaluation theory, which focuses on the effect of feedback and other external events on intrinsic motivation.

Ryan and Deci explain [133, 134] that self-determination theory focuses primarily on the psychological level. It differentiates types of motivation along a continuum from controlled to autonomous. The theory is particularly concerned with how social-contextual factors support or thwart people's thriving by satisfying their basic psychological needs for competence, relatedness, and autonomy. The deprivation or lack of satisfaction of any of these needs will lead to observable decrements in growth, integrity, and wellness.

The basic need for *autonomy* is the need to self-regulate one's experiences and actions. The individual must feel its behavior as self-endorsed or congruent with its authentic interests and values. When behaving as regulated by external forces or by relatively non-integrated aspects of one's personality, individuals may behave without a sense of volition or self-endorsement by their actions. *Competence* refers to people’s need to feel as though they can operate effectively within their life contexts. This need is evident as an "inherent striving, manifested in curiosity, manipulation, and a wide range of epistemic motives." However, "in contexts in which challenges are too difficult, negative feedback is pervasive, or feelings of mastery and effectiveness are diminished or undermined by interpersonal factors such as person-focused criticism and social comparisons." *Relatedness* concerns feeling socially connected. It is the need to experience belonging and feeling significant among others. "Equally important to relatedness is experiencing oneself as giving or contributing to others" [133].

Research has shown that these needs are essential for optimal motivation as well for well-being. When basic needs are thwarted, people will predictably react, with some falling into passive or fragmented modes of functioning or attempting to compensate for what is missing [133].

Ryan and Deci [133] explain that a central dimension used within SDT to differentiate motivation types is the autonomy-control continuum. Types of motivation can be characterized by the extent to which they represent autonomous (behaviors in which the person experiences volition) versus controlled regulations (behaviors in which a person feels externally or internally pressured or compelled to act).

Autonomous and controlled motivation stemmed from early empirical research on intrinsic motivation. In the words of Ryan and Deci [133], "Intrinsically motivated behaviors are those that are performed out of interest and for which the primary "reward is the spontaneous feelings of effectance and enjoyment that accompany the behaviors. Intrinsic motivation contrasts with *extrinsic motivation*, represented by behaviors that are instrumental for some separable consequence such as an external reward or social approval, avoidance of punishment, or the attainment of a valued outcome.

Intrinsically motivated behaviors are, by definition, autonomous; they are experienced as being volitional and emanating from one's self (...). In contrast, extrinsically motivated behaviors can vary widely in the degree to which they are controlled versus autonomous. One can be extrinsically motivated because of externally imposed reward or punishment contingencies, in which case one's behavioral regulation is likely to be characterized as relatively controlled; but one can also be extrinsically motivated insofar as the behavior yields outcomes that are personally valued or important, in which case the behavior is likely to be experienced as relatively autonomous (...). SDT proposes that extrinsic motivation may be more or less internalized to or congruent with one's self, so the degree of internalization reflects the degree to which the behavioral regulation is relatively autonomous versus controlled."

As illustrated by

Figure 2.2 below, within extrinsic motivation, SDT proposes four types of behavioral regulations within extrinsic motivation, from the less internalized to the more internalized with one's sense of self: external, introjected, identified, and integrated.

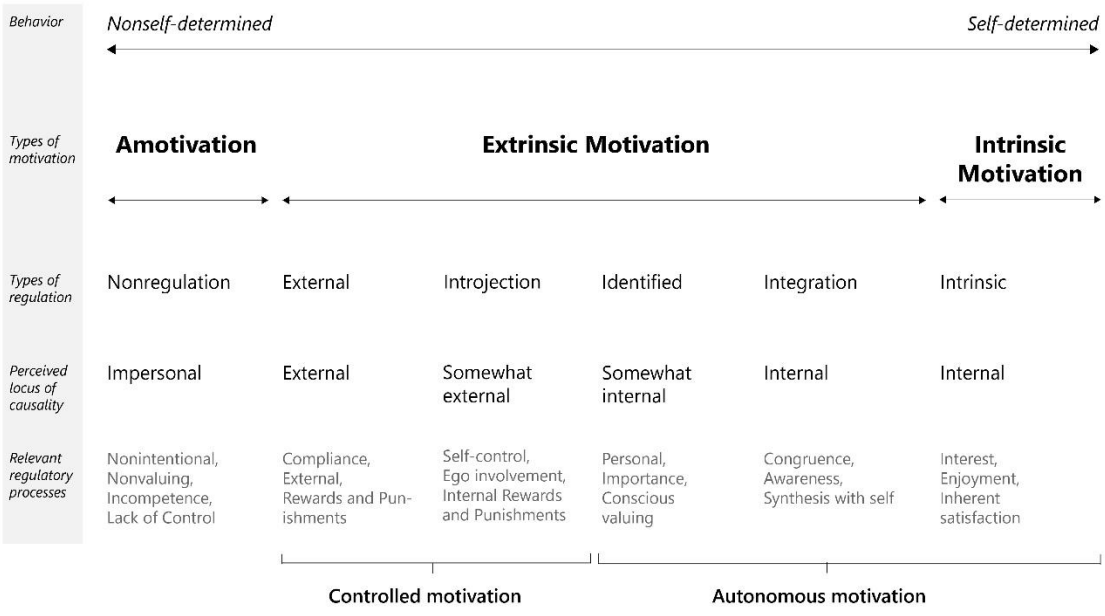


Figure 2.2: The self-determination continuum showing types of motivation with their regulatory styles, locus of causality, and corresponding processes. Figure derived from Ryan & Deci [134].

External regulation. A behavior is externally regulated if it is motivated by a dependency upon an external reward or punishment contingency. People perform the behavior because they expect a separable consequence. “The problem with external regulation is not primarily ineffectiveness, because powerful reward and punishments can control behavior, but is rather lack of maintenance, because without the expectancy in place, behavior is typically not sustained over time” [133]. An example of external regulation in the context of physical exercise is the exerciser who goes to the gym because he feels pressured and controlled by his family’s and friends’ desire for him to attend [145].

Introjected regulation. The second type of most controlled motivation is labeled *introjected regulation*. While external regulation is a form of extrinsic motivation that depends on specific external contingencies, introjection is a process in which there already exists a partial internalization of the external regulation. Here, people partially internalize an extrinsic motivation. Introjection involves taking a regulation but not fully accepting it as one’s own. Behavior is driven by self-approval (to avoid guilt or anxiety or to attain ego enhancements such as pride). Although internally driven, introjected behaviors still have an external perceived locus of causality and are not really experienced as part of the self [145]. Introjected behaviors are couched within self-esteem-related contingencies and are carried out because the individual feels that he/she should act. [133, 145]. An example is an person who would feels ashamed or guilty if he/she were to miss an aerobics session [145].

Identified regulation. A more fully internalized form of extrinsic motivation (already somewhat autonomous motivation) is *identified regulation*. Such behaviors are accepted or owned as personally important. Therefore, individuals will regulate themselves for related actions relatively autonomously. Identification is a type of internalization in which people see the behavior as something personally important for themselves. However, the person’s behavior is still instrumental because it is the usefulness of the activity rather than the activity’s inherent interest that guides participation [145]. An example of identified regulation is the person who chooses (i.e., volitionally engages) to partake in an aerobic-based gym session such as jogging on a treadmill because it feels personally valuable for health [145].

Integrated regulation. Integrated regulation represents the fullest type of internalization and is the basis for the most autonomous form of extrinsic motivation. Integrated regulation involves an activity that is in congruence with the other aspects of one's self and well-internalized life goals (brought into congruence with the individual's other values, goals, and needs) [133, 134,

145]. Actions characterized by integrated motivation share many qualities with intrinsic motivation (e.g., both are autonomous motivation), although they are still considered extrinsic because the action is performed to achieve a separable outcome (rather than for inherent enjoyment) [134]. An example is an individual who exercises as part of a healthy lifestyle and aligns exercise with other valued life goals.

Internalization is defined as the process of taking in values, beliefs, or behavioral regulations from external sources and transforming them into one's own so that, subsequently, they will emanate from one's sense of self [134]. The idea of an internalization continuum (

Figure 2.2), which conveys that a regulation can be more or less fully integrated with one's sense of self, underlines the point that, as people are successful in fully internalizing a regulation, they will experience their behavior as more autonomous or self-determined with respect to the associated actions [133]; greater relative autonomy is associated with higher quality behavior and greater persistence [150].

2.5.1 The Effects of Feedback and Other External Events on Intrinsic Motivation.

Initial external events, such as losing weight, having a well-shaped body, etc., can lead us to start engaging in exercise. However, internal motives—needs, cognitions, emotions—sustain our motivation over a long period [131, 145, 150]. The *cognitive evaluation theory* (CET) represents a formal mini-theory developed within SDT that focuses on factors that facilitate or undermine intrinsic motivation, such as rewards, punishments, evaluations, and feedback [133].

In its most general form, CET [133] suggests that tangible rewards that are salient, expected, or contingent on doing activities tend to undermine intrinsic motivation because they thwart autonomy and prompt change toward an external perceived locus of causality. On the other hand, positive verbal rewards (positive feedback) tend to enhance intrinsic motivation, as long as people feel autonomous rather than evaluated or controlled. This enhancement of intrinsic motivation through positive feedback often occurs by increasing the individual's perceived competence. Nonetheless, these statements do not provide a complete picture of cases in which various external events are likely to enhance, diminish, or leave unchanged intrinsic motivation.

An interesting point about extrinsic rewards is that while, in general, they diminish autonomy, the receipt of the reward is an event that people often feel positive about [133].

Following SDT principles, events influence motivation by altering the individual's experience of the situation. Therefore, Deci and Ryan [37, 38] suggest that the effect of rewards and other

events depends on the meaning or interpretation that the recipient gives to them regarding autonomy and competence.

External events have three components, each with a functional significance: informational, controlling, and amotivating. "The *informational aspect*, which conveys information about self-determined competence, facilitates an internal perceived locus of causality and perceived competence, thus supporting intrinsic motivation. The *controlling* aspect, which pressures people to think, feel, or behave in particular ways, facilitates an external perceived locus of causality, thereby diminishing intrinsic motivation. The *amotivating* aspect, which signifies incompetence to obtain outcomes and/or a lack of value for them, undermines both intrinsic and extrinsic motivation and promotes amotivation. The relative salience of these three aspects for the person, which can be influenced by factors in the interpersonal context and in the person, determines the functional significance of the event, and thus its impact on intrinsic motivation" [133].

Suppose a reward is interpreted by people on average as an external agent to get the person to do something. In that case, its functional significance is likely to be controlling and, therefore, to undermine intrinsic motivation. "Yet if the reward is interpreted in a way that is seen as acknowledging a job well done or as conveying appreciation for efforts, then it is more likely to be experienced as informational and thus to sustain or enhance intrinsic motivation" [133].

To clarify the complexities of rewards and their likely relations to functional significance and hence intrinsic motivation, Deci, Ryan and colleagues [32, 132, 133] developed and refined a taxonomy of reward types and described how each might affect intrinsic motivation (Table 2.3).

In general [35], *task-noncontingent* rewards do not undermine intrinsic motivation (because they are not experienced as controlling). In contrast [132], *task-contingent rewards* might have a more detrimental effect on intrinsic motivation (as they are likely to the interpreted as controller of behavior and therefore conduct to an external perceived locus of causality). In turn, both *completion-contingent* and *engagement-contingent* rewards are likely to undermine intrinsic motivation [33][Deci and colleagues (1999)]. Deci and Ryan [133] explain, "Specifically, with engagement-contingent rewards, because people have to work on the task to get the reward, the reward is likely to be experienced as a controller of their task behavior. Moreover, because the reward carries little or no competence affirmation, it is unlikely to increase perceived competence, so there would be no positive influence on intrinsic motivation. With completion-contingent rewards, people have to complete the task to receive the rewards, so the rewards are likely to be experienced as even more controlling because the individuals not only have to work on the activity but they also have to complete it in order to get the rewards."

Table 2.3: Contingencies used for administering **tangible** rewards that are expected and salient. Adapted from [133].

Type of contingency	**Definition**
Task-noncontingent	Reward is given simply for being present and does not specifically require actually being engaged with the target activity.
Engagement-contingent	Reward is given for spending time being engaged with the target activity.
Completion-contingent	Reward is given for completing a target activity (sometimes within a time limit).
Task-contingent	Refers to a large category containing both engagement-contingent and completion-contingent rewards.
Performance-contingent	Reward is given for reaching a specific performance standard, for example, doing better than 80% of other people who have done it.
Competitively contingent	Reward is given to the winner of a competition and the loser gets lesser or no rewards

Regarding *performance-contingent* rewards, because they are salient and demanding, they are likely to undermine intrinsic motivation. However, "given both the controlling and competence-affirming aspects of these rewards, their effects are expected to be somewhat variable and to be influenced by additional considerations, such as how they are applied and the features of the social context" [133]. Finally, regarding competitively contingent rewards in circumstances in which a goal is to enhance everyone's motivation, "such as in education, public health interventions, environmental initiatives, and other applied settings, the use of such contingent reward structures can often produce unintended negative effects," as the majority of the people will not receive the reward. Those who are likely to experience both low autonomy and low competence are also the ones who are unlikely to receive the award [133].

2.5.1.1 Positive Feedback (Verbal Rewards)

Positive feedback whose informational aspect is more salient to individuals than its controlling aspect facilitates intrinsic motivation. Praise that is perceived as mainly evaluative and/or controlling does not. Moreover, feedback that enhances perceived competence also enhances intrinsic motivation [75]. For example, some studies [33, 171] found a significant difference between the effect of positive feedback on school-age children and college students. Positive feedback significantly enhanced the intrinsic motivation of college students, but not of children. Deci and Ryan explain [133] "Presumably, whereas college students focused on the informational aspects of the praise, for children praise may often be experienced as a form of control, offsetting any positive effect the competence affirmation might have had".

When individuals engage in activities that provide mastery and optimal challenge opportunities, positive feedback will enhance their intrinsic motivation. Research "also suggests that the beneficial effects of positive feedback radiate to feelings of vitality and energy [109] and enhanced concentration during task engagement [65], among other benefits" [133].

Task-inherent (accompanying the performance of the tasks) or naturally occurring positive feedback (e.g., as people climb a mountain, they experience the ongoing results of their efforts in the progress they make) are likely to be experienced as informational rather than controlling. On the other hand, positive feedback mediated through others can be perceived as either informational or controlling, depending on how it is administered. For example, Ryan [130] showed this point in a study. Positive feedback that was provided in an informational way enhanced intrinsic motivation, while positive feedback that was provided in a controlling way undermined intrinsic motivation.

Nonetheless, "there are complexities to the effects of positive feedback on intrinsic motivation. Children may be especially sensitive to the controlling aspects of praise, perhaps as we speculated because adults so often try to use praise to ‘motivate’ them. Positive feedback has also been found to enhance intrinsic motivation for optimally challenging tasks but not for tasks that were too easy,” [30, 133] for example.

Studies [65, 161, 163] also found that the need for competence has a mediating role between positive feedback and intrinsic motivation. "The positive effects of competence affirmation on intrinsic motivation accrue only when the recipient of feedback feels at least some degree of personal autonomy with respect to the behavior and its outcome" [133].

Lastly, regarding language, studies have found [90, 130] that positive feedback involving controlling language (e.g., "Good, you did just as you should") has negative rather than positive effects. "When the positive feedback was delivered with a controlling style, the control not only

neutralized the potentially positive effect of the competence information but could even undermine intrinsic motivation" [133]. Following Deci and Ryan [133] some evidence [57, 135] "indicates that positive feedback enhances intrinsic motivation only if the person experiences an I-PLOC [internal perceived locus of causality] for the behavior and a sense of ownership over the lauded performance." Further, if the praise provides no meaningful information about one's competence, the recipient will likely not perceive it as informational, but perhaps instead feel that it was controlling. "In short, for positive feedback to have positive effects on intrinsic motivation, the communicator would generally need to have the intention of informing and acknowledging, rather than 'motivating' or controlling."

2.5.1.2 Negative Feedback

Research has indicated that negative performance feedback tends to decrease intrinsic motivation relative to both positive feedback and no feedback [36, 161]. When the individual's competence deteriorates, either explicitly or implicitly, he/she tends to lose intrinsic motivation. Nevertheless, it is worth noting that in some circumstances, negative feedback can be very informational and ultimately competence-supportive [17], whereas in others it is simply amotivating.

Deci and Ryan [133] explain that "intrinsic motivation is facilitated by optimally challenging activities, ones for which people could expect to fail some of the time and succeed some of the time. This implies that a modest amount of negative feedback on an activity that stretches people's abilities may actually serve to challenge and thus motivate, rather than demotivate. (...) When people present negative feedback in a way that pressures and demeans the recipients, for example, by calling their worth into question, the negative feedback may be devastating [19, 92]. But it is also possible for people to provide negative feedback in a more constructive way, a way that approaches poor performance outcomes not as a reason to humiliate the performers but as a problem to be discussed and solved in an open-minded, interactive way."

Mouratidis and colleagues (2010) [108], for example, showed that in a sport context, the perceived autonomy-supportive versus controlling style of providing constructive feedback of coaches yielded different motivational consequences. Also, Carpentier and Mageau (2013) [19] showed that 'coaches' attitudes toward change-oriented feedback, when clearly intended to improve and aid athletes, enhanced rather than diminished motivation.

Lastly, Ryan and Deci [133] also discuss the effects of negative feedback on extrinsic motivation. "Specifically, not only could negative feedback imply that people are not competent at some interesting activity but it could also imply that they do not have control over desired extrinsic outcomes. In other words, negative feedback could decrease their extrinsic motivation,

as well as their intrinsic motivation, leaving them with a high level of amotivation. Specifically, feedback implying that one is incompetent has been found to produce personal helplessness, which is one type of amotivation."

To summarize, the cognitive evaluation sub-theory of self-determination theory assumes that social-context events do not cause intrinsic motivation. On the contrary, inherent motivation is understood as evolving an innate human propensity that can be enhanced or diminished by social-contextual factors [133]. That is, events influence motivation by altering the individual's experience of his/her situation. Events can have different functional significances, defined in terms of how the event impacts experiences of autonomy and competence [133]. Autonomy is defined as the basic human need to feel effectance and mastery, while competence is defined as the basic human need to self-regulate one's experience and actions. Events experienced as controlling—meaning experienced as an external pressure that compels people to think, feel, or behave in a particular way—undermine intrinsic motivation (people's sense of autonomy). On the other hand, events experienced as informational—that affirm or promote autonomy and competence—facilitate an internal perceived locus of causality and perceived competence and, thereby, support intrinsic motivation.

Negative feedback tends to deteriorate perceived competence and thus undermine intrinsic motivation. In contrast, positive feedback (also recognized as verbal rewards or praise) enhances a sense of mastery or competence, thus enhancing intrinsic motivation [34, 38, 133]. Still, when positive feedback is experienced as an external evaluation, pressure, or control, (i.e., is made overly salient), people tend to experience it as controlling, which results in no enhancement or the diminishment of intrinsic motivation [76, 130]. Ultimately, the impact of positive feedback depends on how it is administered [38].

3

Text Messages and Aesthetic Pleasure

In this chapter, we present two studies: one study exploring how motivational text messages promote exercise motivation, and a second study exploring the influence of aesthetic pleasure on short-term exercise motivation.

3.1 Study 1: How do Motivational Text Messages Promote Exercise Motivation: An Exploratory Study

In this study, we explored (1) why individuals seek motivational text messages and how the messages support exercise motivation, and (2) what value individuals attribute to motivational text messages embedded in aesthetically appealing visual presentations.

3.1.1 Overview

We first designed an exploratory survey to examine these aspects and tested it in 20 individuals who view and seek motivational text messages regularly. We then surveyed 160 people who also see and seek motivational text messages regularly and classified them regarding their exercise habits (regular and non-regular exercisers).

We addressed the following: (1) An empirical description of why regular and non-regular exercisers seek motivational text messages and how the messages support their exercise motivation; (2) What main types of exercise motivation and behavior regulations are present, in

each of the groups, in those who regularly exercise (EX), and in those who do not (Not EX); (3) What value individuals attribute to aesthetically appealing visual presentations, and what is their value compared to the textual content of the message. We then discussed the broader implications of our findings for activity tracking services, considering how the development of motivational text messages features in activity trackers services can be influenced by the profile of individuals who actively seek motivational text messages.

3.1.2 Study Design

Researchers started by creating an exploratory pilot survey constituted mainly by open-ended questions (to identify frequent reasons for seeking motivational text messages related to physical exercise) and tested it with 20 individuals from Amazon Mechanical Turk.

All individuals reported seeing motivational text messages (messages that encourage people to exercise) regularly and actively seek them (individuals were pre-screened through a similar process described below in Participants). Considering the answers from this pilot survey, researchers created then a final survey, in which, they transformed the open-ended questions into closed-ended questions. Next, we describe the study and results of the final survey.

3.1.2.1 Participants

The target individuals for this study were individuals who see and actively seek motivational text messages on a regular basis. Within this general profile, we were interested in comparing similarities and differences (above all in the types of motivation to exercise) between individuals (a) who exercise regularly (group EX) and (b) individuals who never exercise or do not exercise regularly (group Not EX).

To recruit the same number of individuals for each group (EX and Not EX), we created two "hits" (surveys) in Amazon Mechanical Turk, both with screening questions. Both hits had the same three screening questions. The first two screening questions asked if the individuals frequently see motivational text messages and actively seek them out. Individuals had to answers “yes” to both questions to be considered.

The third screening question required a different answer to be accepted and served the purpose to classify individuals within the general target profile (exercisers versus not-exercisers), as well to control the number of individuals recruited within each group. A total of 160 valid individuals were recruited, with 80 in each group. The hit that had as final target audience exercisers (the group EX) rejected individuals who reported being non-exercisers. The hit that had as target audience non-exercisers (the group Not EX) rejected individuals who reported being

exercisers. All participants were recruited from Amazon Mechanical Turk, and had to meet the qualification requirements: having location equal to the US, having a number of HITs approved greater than 500, and lastly, having a HIT approval rate greater than or equal to 99%. Individuals started by being informed that the survey had three closed-ended qualifying questions and that they will not get paid answering these. Participants acknowledged that their participation in the study was voluntary and they agreed not being paid answering the qualifying questions. Participants were informed that they can choose to terminate their participation in the study at any time and for any reason. Individuals who passed the screening questions were invited to complete the survey. Participants were compensated with $1.00 and the survey took on average 5 minutes and 50 seconds to complete. IP addresses of participants were analyzed to detect multiple submissions. There were no instances of multiple submissions.

The structure of the survey questions is as follows:

(1) Exercise Profile. If the participant had stated that they exercise regularly in the screening questions, then they were asked how often they exercised and how long they have been exercising regularly. If the participant stated they do not exercise regularly in the screening questions, they were asked if they were thinking of starting to exercise regularly in the next three months;

(2) Messages View Habits. Participants were asked the following questions regarding their message view habits: (2.1) Participants were asked how long ago they began noticing motivational text messages, for what reasons, where and when they saw motivational text messages. (2.2) How participants saw the motivational text messages presented to them (e.g., as text-only or embedded in a visual presentation), and how they preferred to see them. (2.3) Did having the motivational text messages be presented in an aesthetically appealing presentation instill a positive feeling? (2.4) Is the visual presentation of a motivational text message as important as what the message says?

(3) Types of Exercise Motivation. BREQ3 scale [103, 173];

(4) Demographics. Age, gender, nationality, education.

(5) Comments or suggestions (optional).

3.1.3 Results

The presentation of the results follows this order: demographic characterization, exercise profiles, motivational text messages - for what, where and when, motivational text messages presented as text-only or embedded in a visual presentation, and lastly, differences in the types of exercise motivation.

3.1.3.1 Demographic Characterization

Age and gender. Individuals in the EX group were slightly older (the sample's median age was 31 years [min. = 20, max. = 63]) than those in the Not EX group (the sample's median age was 29 years [min. = 19, max. = 58]). In both groups, there were more men than women. The number of men and women in the Not EX group was relatively similar (38 female [47%], 42 male [53%]). In group EX there was a difference of 20% between the genders of participants (32 female [40%], 48 male [60%]), which might have led to gender bias within this group.

Education. None of the participants, in both groups, had less than a high school diploma. Most participants in both groups had a bachelor's degree (48% in EX group, 66% in Not EX group), followed by those who reported having some college, but no degree in the case of the EX group (20% of the EX participants), and by those who reported having an associate's degree in the case of the Not EX group (13% of the Not EX participants).

3.1.3.2 Exercise Profiles

The exercise profile of the groups EX (the regular exercisers) and Not EX (non-regular exercisers) is as follows:

Group EX – Regular Exercisers. This group is characterized mainly by individuals that exercise often, at least three times a week (Figure 3.1). They are long-term exercisers (the majority of the participants have been exercising for at least more than 6 months) (Figure 3.2) and started seeing motivational text messages accordingly to the period they started to exercise (Figure 3.2).

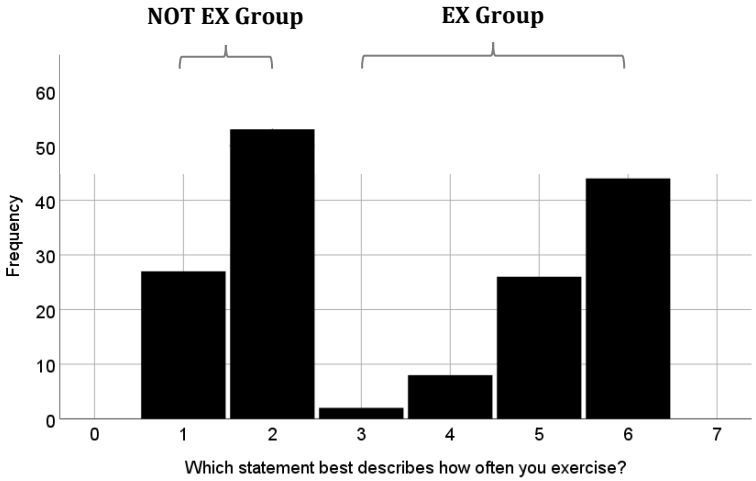


Figure 3.1: How often participants exercise. 1= I never exercise, 2= Once in a while, 3= Once a week, 4= Twice a week, 5= Three times a week, 6= More than three times a week. (The point 1 and 2 correspond to the participants in the Not EX group. The point 3, 4, 5, 6 and seven correspond to the participants in the EX group).

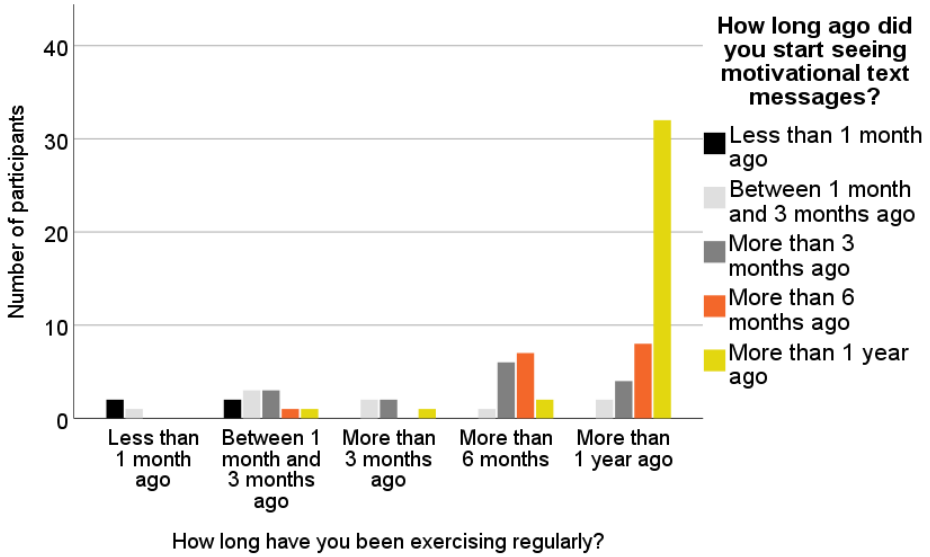


Figure 3.2: How long have participants in the group EX been exercising regularly clustered by how long they started seeing motivational text messages.

A Kendall's tau-b correlation was run to determine the relationship between how long EX participants have been exercising regularly and how long they had started seeing motivational text messages. There was a strong, positive association between how long they exercise and how long they started seeing motivational text messages, which was statistically significant, $\tau b = .602$, $p = .001$.

Group Not EX – Non-Regular Exercisers. This group is characterized by individuals that typically only exercise occasionally or never exercise (Figure 3.1, point 1 and 2).

Most of the individuals have the intention to start exercising within a month (Figure 3.3), and they started seeing motivational text messages mainly less than 6 months ago (Figure 3.3, points: Less than 1 month ago, between 1 month and 3 months ago, and more than 3 months ago).

There was not a pattern regarding how long they started seeing motivational text messages and their intention to start exercising (Figure 3.3), as confirmed by Kendall's tau-b correlation test.

A Kendall's tau-b correlation was run to determine the relationship between how long Not EX participants started seeing motivational text messages and their intention to exercise in the next three months. There was an extremely weak, negative association between both variables, which was not statistically significant, $\tau b = -.007$, $p = .939$.

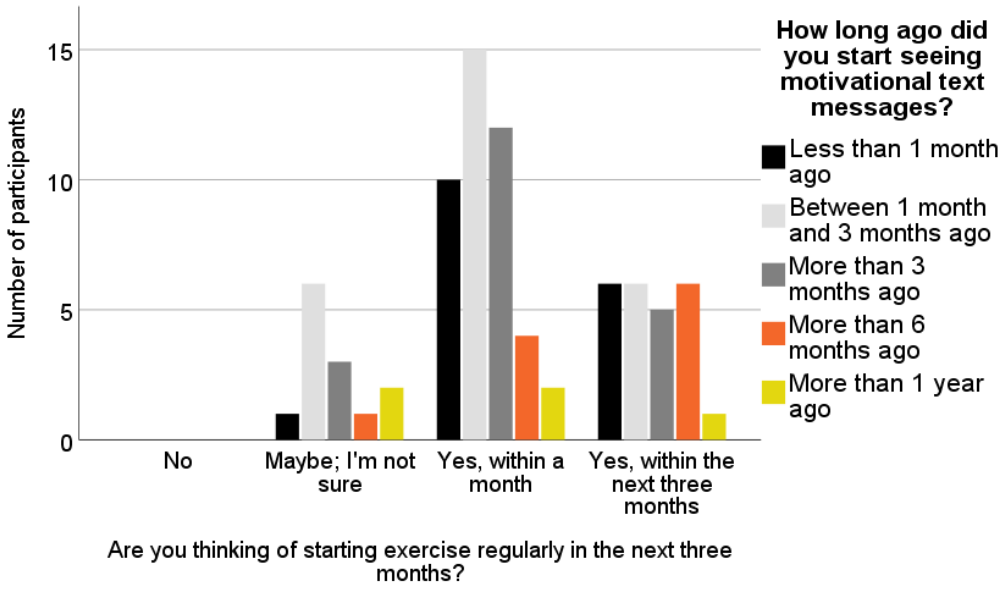


Figure 3.3: Whether participants in the group Not EX are planning to start exercising regularly soon clustered by how long they started seeing motivational text messages.

3.1.3.3 Motivational Text Messages – For What, Where, and When

The majority of the participants in both groups look for motivational text messages with the only purpose of trying to boost their exercise motivation (Figure 3.4, A).

A considerable number of participants look for motivational text messages to try to boost their exercise motivation, remind them of their exercise goals and the benefits of exercising (Figure 3.4, ABC).

However, groups differ in their third main reason to look for motivational text messages. In the Not EX group the third top reason to look for motivational text messages is to remind participants of their exercise goals. In the EX group, the third top reason to look for motivational text messages combine reasons B and A: remind participants of their exercise goals and try to boost their exercise motivation.

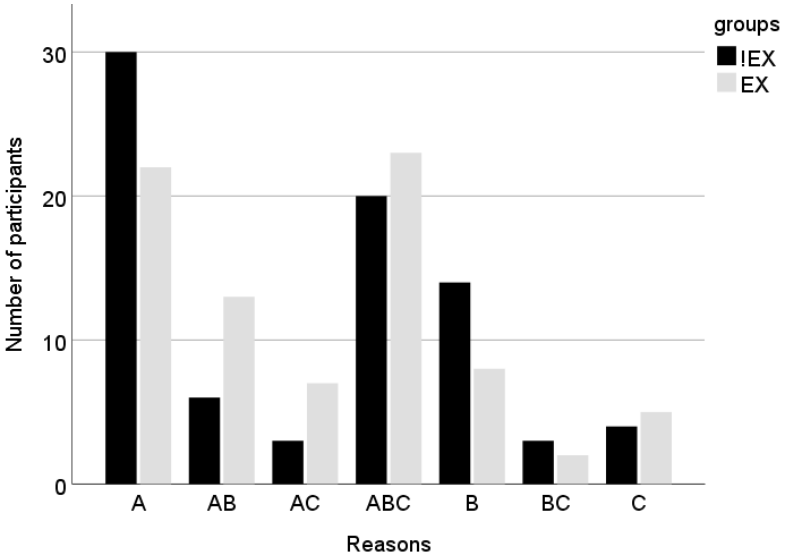


Figure 3.4: What are the main reasons for seeking motivational text messages in each group of participants. A= To try to boost my exercise motivation, B= Because they remind me of my exercise goals, C= Because they remind me of the benefits of exercising, D= Other.

Both groups visualize motivational text messages mainly on social media platforms and online forums (Facebook, Youtube, Instagram, Twitter, Reddit). In the case of the Not EX group, participants also reported to receive them from friends or family (Figure 3.5, AC).

In the case of EX participants, they also reported to receive motivational text messages in apps and from friends and family (Figure 3.5, ABC).

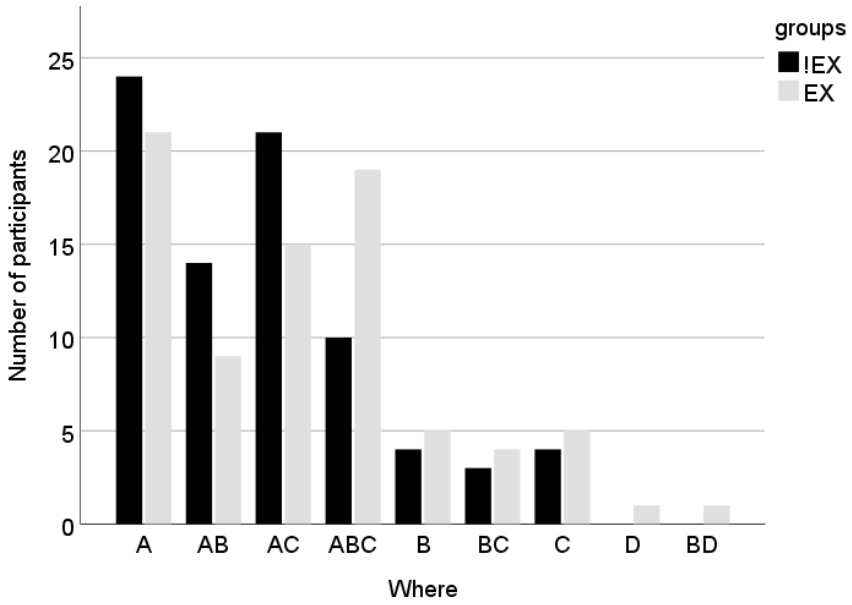


Figure 3.5: Where participants usually see motivational text messages. A= Social media platforms and online forums (Facebook, YouTube, Instagram, Twitter, Instagram, Reddit), B= Apps, C= Sent by friends or family, D= Other.

In total, two participants selected option D (Figure 3.5, D and BD) and reported finding motivational text messages in the gym.

Individuals in the EX group, the regular exercisers, reported seeing motivational text messages primarily before working out, and when they check social media (Figure 3.6, AB).

Individuals in the Not EX group, the non-regular exercisers, reported seeing motivational text messages mainly when they check social media.

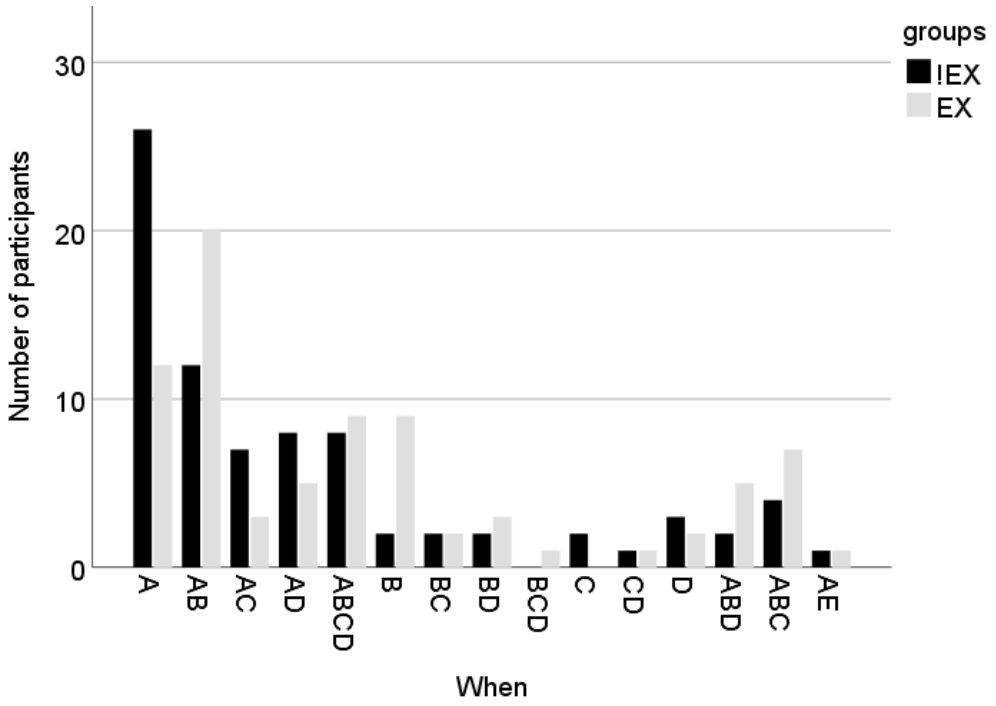


Figure 3.6: When do participants usually see motivational text messages. A= When I check social media, B= Before working out, C= After working out, D= When I miss the motivation to go exercising, E= Other.

3.1.3.4 Text Messages Presented as Text-Only or Embedded in a Visual Presentation?

The majority of all participants (in groups EX and Not EX) usually see motivational text messages presented as text-only, as well, as embedded in a visual presentation (Figure 3.7).

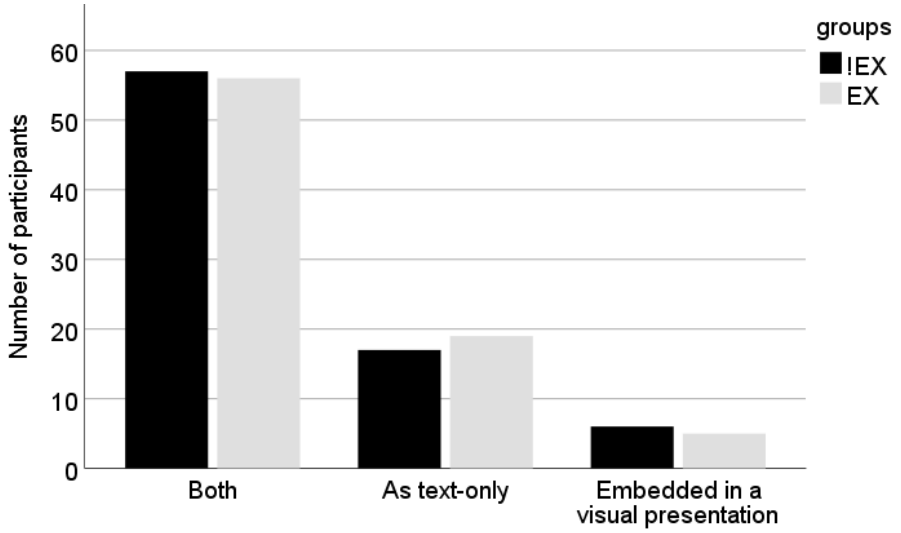


Figure 3.7: How participants usually see motivational text messages presented.

In both groups, individuals tend to have a preference to visualize motivational text messages presented as a "mix", sometimes as text-only and sometimes embedded in a visual presentation (Figure 3.8).

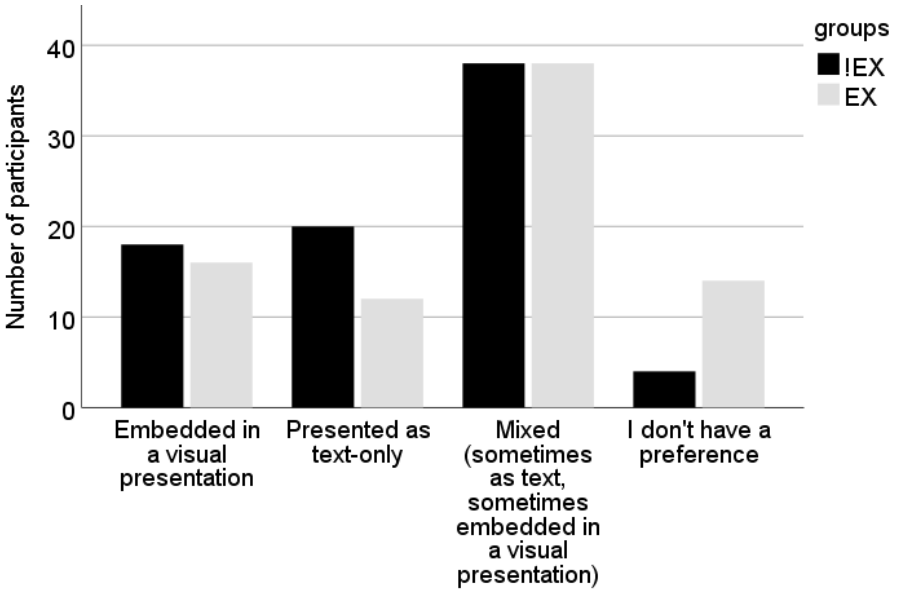


Figure 3.8: How participants prefer to see motivational text messages.

The vast majority of the participants indicated that an aesthetically appealing visual presentation helps to instill a positive feeling relative to the text (Figure 3.9).

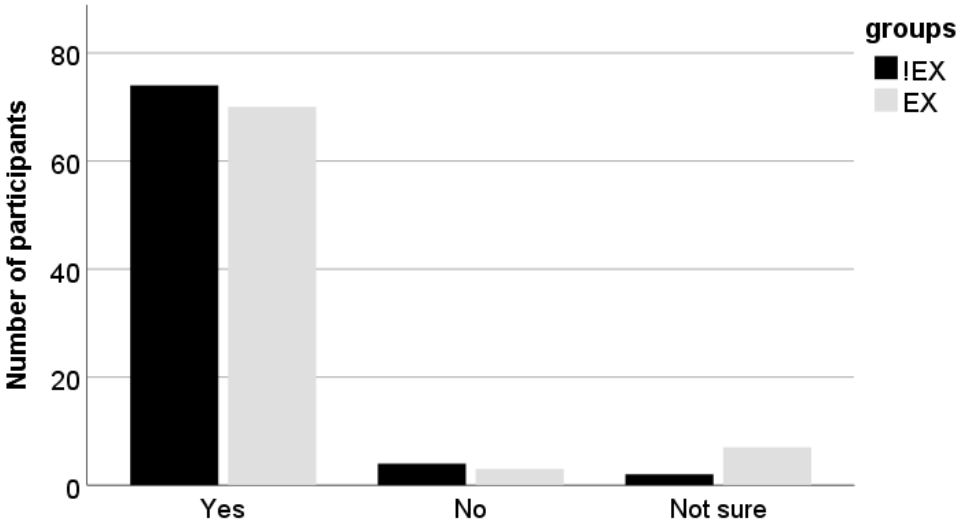


Figure 3.9: Would you say that visualizing a motivational text message embedded in an aesthetically appealing visual presentation helps to instill a positive feeling relative to the text?

Lastly, the visual presentation of a motivational text message was considered as being as important as the textual content in both groups (Figure 3.10), and only a very small part of the participants indicated that the visual presentation is more important for them than the textual content (Figure 3.10).

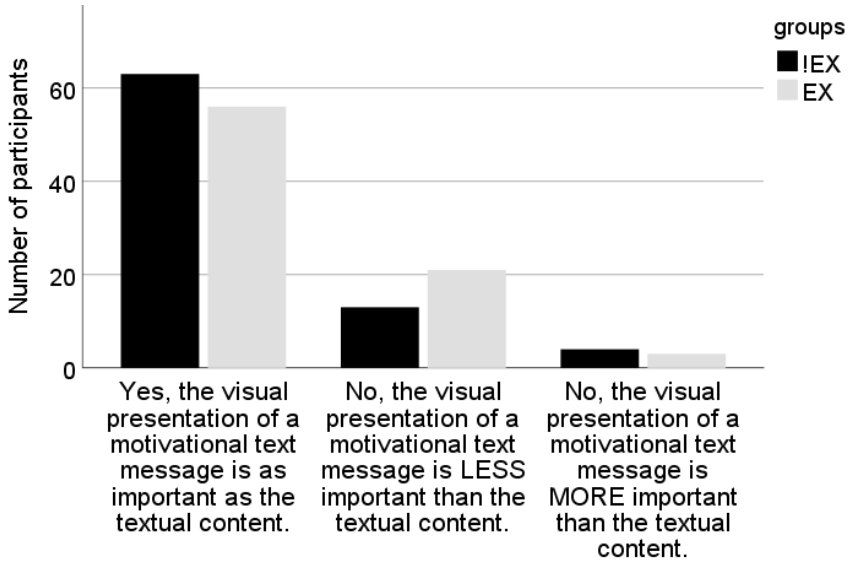


Figure 3.10: Would you say the visual presentation of a motivational text message is as important as the textual content?

3.1.3.5 Differences in The Types of Exercise Motivation

Following the different types of motivation individuals can have to perform a certain behavior, according to self-determination theory [39, 134]), as well as previous findings related to exercise motivation and predicting exercise adoption and exercise compliance among adults [127, 131, 145, 150], we measured the participants on their different types of exercise motivation, through the BREQ-3 scale [103, 173]. The types and levels of motivation of the participants were then compared to the results of published literature.

In self-determination theory [134], controlled and autonomous motivation designate the "quality" of motivation and varies from low-self-determined to self-determined. The terms amotivation, extrinsic motivation (from external factors to the activity), and intrinsic motivation (from internal factors) designate the type of motivation present in individuals. Some of the behavior regulatory styles of extrinsic motivation are considered controlled motivation (external and introjected regulations) while the ones close to self-determined behaviors are already within autonomous motivation (identified and integrated behavior regulations). Intrinsic motivation is the prototype of self-determined motivation.

As expected, individuals in the EX group, present high levels of intrinsic motivation (Figure 3.11), as well as, extrinsic and autonomous motivation (Figure 3.12 and Figure 3.13).

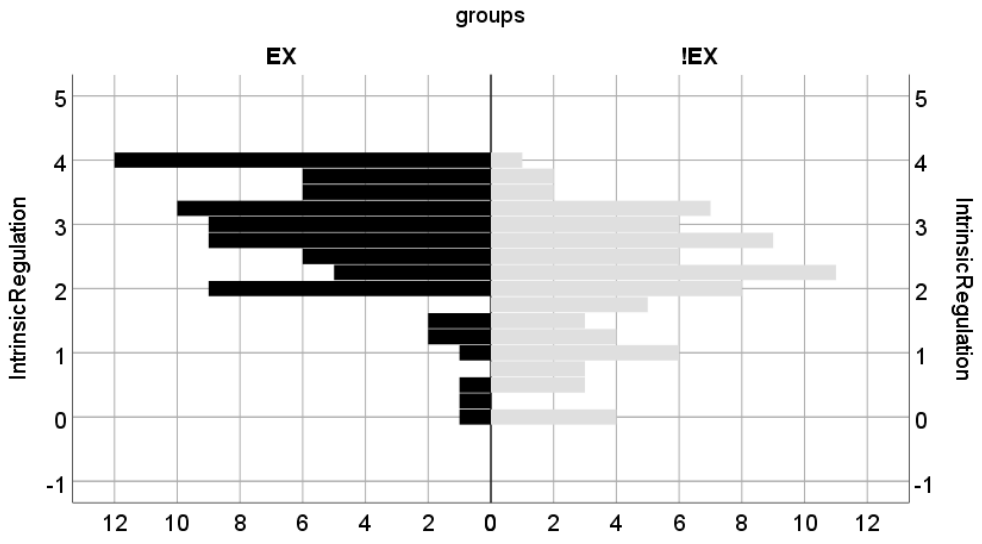


Figure 3.11: Histogram of intrinsic behavior regulation scores by groups.

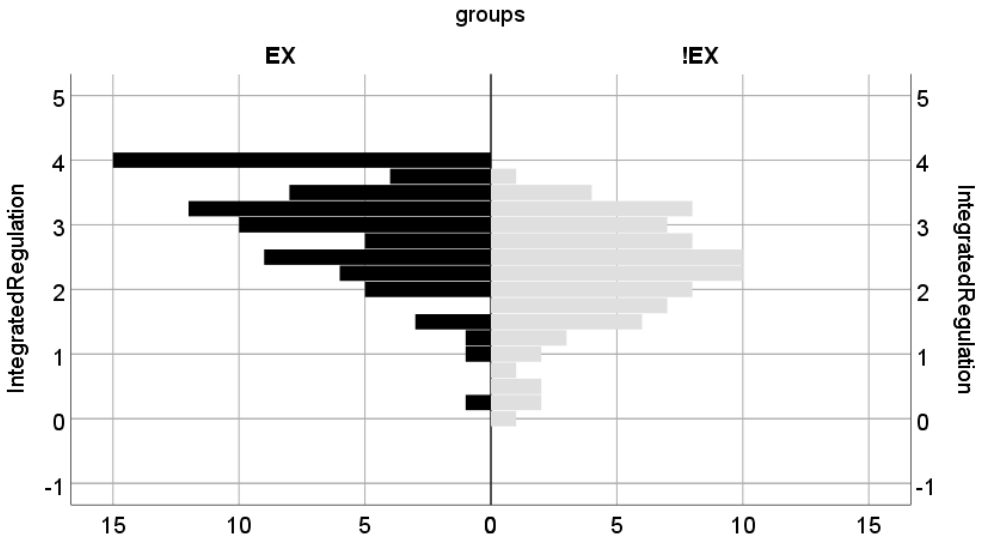


Figure 3.12: Histogram of integrated behavior regulation scores by groups.

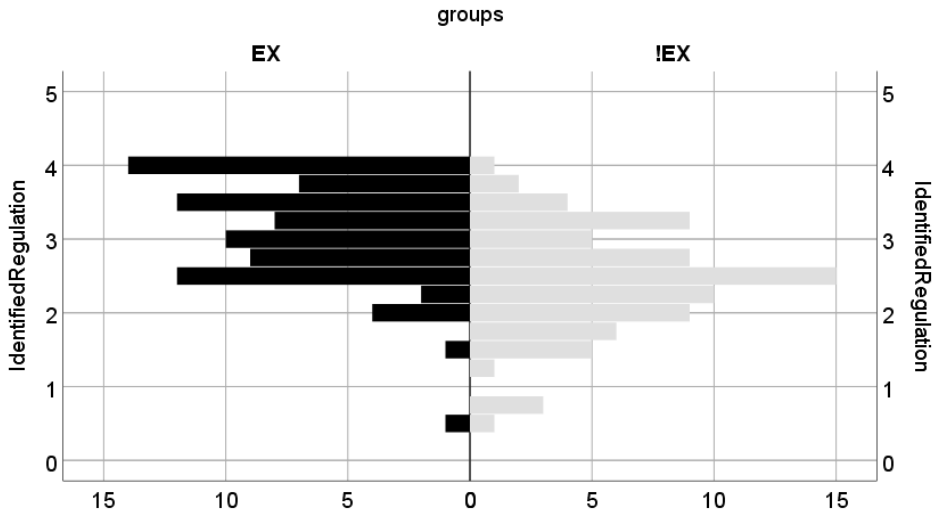


Figure 3.13: Histogram of identified behavior regulation scores by groups.

Moreover, these individuals also present low levels of amotivation (Figure 3.14), as well as between small (external regulation) and medium levels (introjected regulation) of extrinsic and controlled motivation (Table 3.1, Figure 3.15 and Figure 3.16).

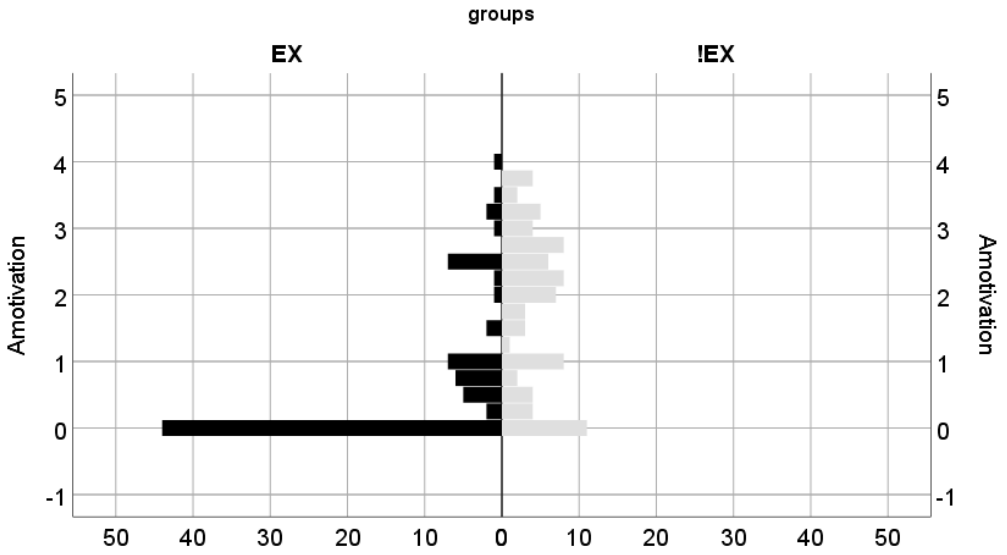


Figure 3.14: Histogram of amotivation scores by groups.

Table 3.1: The median for all types of exercise motivation (BREQ—3 scale, values from 0 to 4) in EX and Not EX groups.

	Amotivation	External	Introjected	Identified	Integrated	Intrinsic
Not EX	2.00	2.25	2.62	2.50	2.25	2.25
EX	.00	1.12	2.50	3.25	3.00	3.00

Individuals in the Not EX group tend to present medium levels of all types of exercise motivation (Table 3.1), as we can see on Figure 3.14 (levels of amotivation), Figure 3.16 (external regulation), Figure 3.15 (introjected regulation), Figure 3.13 (identified regulation), Figure 3.12 (integrated regulation), and Figure 3.11 (intrinsic regulation).

Comparison of Motivation Levels Between Groups. Statistical tests have confirmed that there is significant differences between the levels of all types of behavior regulation, except in the introjected regulation, between EX and Not EX groups.

The EX group present lower levels of amotivation, as well as external regulation, than the Not EX group. The EX group present higher levels of extrinsic and autonomous motivation, as well as intrinsic motivation than the Not EX group (Table 3.1).

These results are in line with what was observed in previous research works [127, 131, 145, 150]. Intrinsic and extrinsic as well as autonomous motivation is typically present in individuals who regularly exercise.

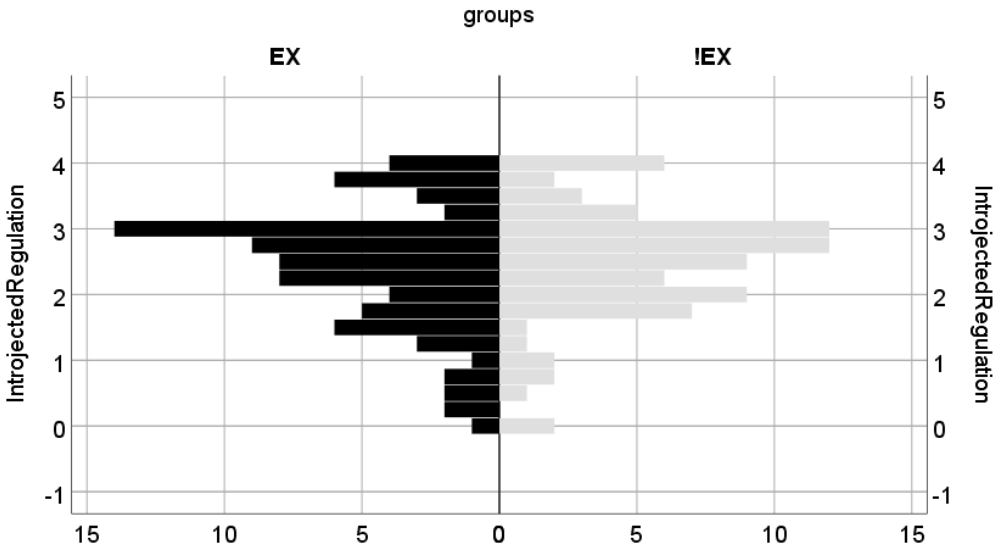


Figure 3.15: Histogram of introjected behavior regulation scores by groups.

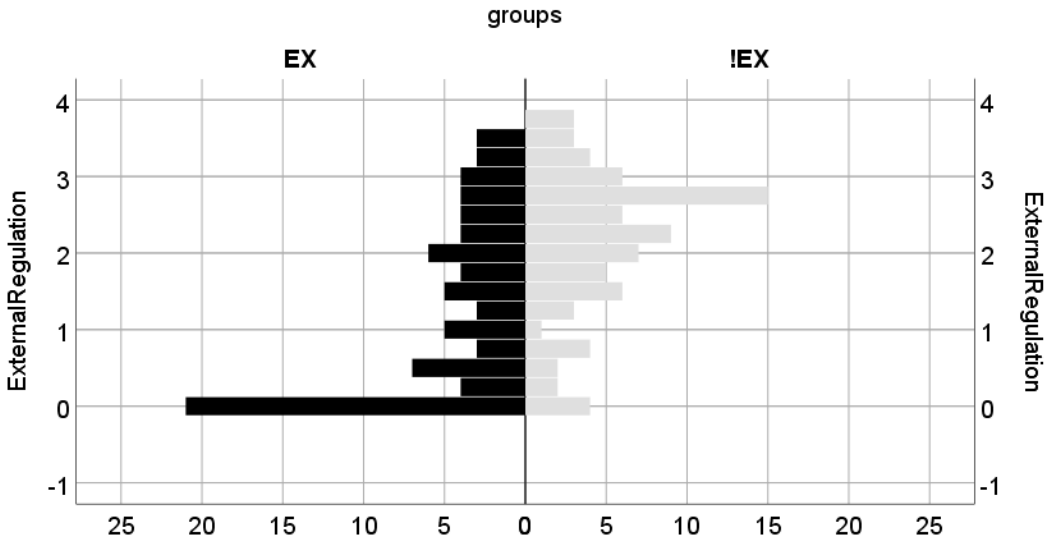


Figure 3.16: Histogram of external behavior regulation scores by groups.

Next, the results of the statistical tests that compared the levels of the different types of motivation between each group are presented.

Amotivation. A Mann-Whitney U test was run to determine if there were differences in amotivation score between EX and Not EX groups. Median amotivation score was statistically significantly higher in Not EX (2.00) than in EX (0.00), U = 1540.500, z = -5.789, p = .001.

External Regulation. A Mann-Whitney U test was run to determine if there were differences in external regulation score between EX and Not EX groups. External regulation scores for EX (mean rank = 64.22) were statistically significantly lower than for Not EX (mean rank = 96.78), U = 1897.500, z = -4.463, p = .001.

Introjected Regulation. A Mann-Whitney U test was run to determine if there were differences in introjected regulation score between EX and Not EX groups. Median introjected regulation score for EX (2.63) and Not EX (2.50), was not statistically significantly different, U = 3066.500, z = -.458, p = .647.

Identified Regulation. A Mann-Whitney U test was run to determine if there were differences in identified regulation score between EX and Not EX groups. Identified regulation scores for EX (mean rank = 101.41) were statistically significantly higher than for Not EX (mean rank = 59.59), U = 4872.500, z = 5.740, p = .001.

Integrated Regulation. A Mann-Whitney U test was run to determine if there were differences in integrated regulation score between EX and Not EX groups. Integrated regulation scores for EX (mean rank = 99.83) were statistically significantly higher than for Not EX (mean rank = 61.17), U = 4746.500, z = 5.300, p = .001.

Intrinsic Motivation. A Mann-Whitney U test was run to determine if there were differences in integrated regulation score between EX and Not EX groups. Intrinsic regulations scores for EX (mean rank = 97.93) were statistically significantly higher than for Not EX (mean rank = 63.07), U = 4594.500, z = 4.776, p = .001.

3.1.4 Discussion

Our exploratory surveys showed that individuals who exercise regularly and see motivational text messages regularly (the EX group) use motivational text messages with the general purpose of trying to boost their exercise motivation, as well as to remind themselves of their exercise goals, and the benefits of exercising. Goal reminders have shown to help individuals continue to pursue their goals [78, 125]. Reminders can also help to conscious valuing an activity what might help to increase the identified behavior regulation [157] which is linked with the initial adoption of exercise [150].

The regular exercisers reported they started exercising and started seeing motivational text messages in a similar period of time, and statistical tests, showed a positive correlation between both. This might suggest that this type of profile of individuals (regular exercisers) have been using motivational text messages to strengthen their exercise motivation, and not that

motivational text messages triggered a change of behavior. However, follow-up contact with this population would be useful to confirm this finding.

Individuals in the group Not EX, non-regular exercisers, tend to look for motivational text messages as a way to boost their exercise motivation. The assessment of the different types of exercise motivation showed that this group of individuals tend to present similar levels of self-determined and non-self determined exercise motivation, which might explain why there was no change in their behavior. These individuals tend to present relatively medium levels of all types of motivation (Table 3.1). They are not particularly demotivated or controlled and extrinsically motivated, as well as not particularly intrinsically motivated.

This might suggest that, in general, if the individuals do not have high levels of self-determined exercise motivation, the motivational text messages might not be enough to help individuals start having regular exercise habits. A notable number of individuals who do not exercise regularly reported seeing motivational text messages already more than three months ago and less than six months ago.

Regarding the importance of the visual presentation, and in particular, the aesthetic appeal, both groups presented the same opinions. Both tend to see motivational text messages presented as text-only, as well as embedded in a visual presentation. Both prefer to see them in a mixed way, sometimes as text and sometimes embedded in a visual presentation, and not only seeing them as text-only or solely embedded in a visual presentation. However, we do not know why they prefer to view motivational text messages presented in a mixed way. We suggest exploring this question in future work.

It was found that, in both groups, participants felt that an aesthetically appealing visual presentation helps instill a positive feeling regarding the textual content. This result can be seen as being in line with HCI literature. Non instrumental qualities, such as aesthetically appealing, can contribute to a positive user experience or general impression about a product [67, 70]. Regarding the importance of the visual presentation, the majority of the participants in both groups reported that for them the visual presentation is as important as the textual content. However, in our study, we did not explore why individuals say so. We suggest as future work, an in-depth exploration about this topic.

3.1.5 Conclusions

We contribute to an initial understanding of why different profile of exercisers, regular and non-regular, look for motivational text messages, how motivational text messages support exercise motivation, and in general, what is the importance of an aesthetically appealing visual

presentation. Activity trackers services should support motivational text messages presented as text-only as well as with an appealing visual presentation. Using motivational messages that remind their users of their goals, as well as the benefits of exercising, might help regular exercisers engage with their service. On the other hand, future studies are needed to conduct further research to understand how motivational text messages could match the needs of non-regular exercisers, and thus hopefully help them to become regular exercisers.

3.2 Study 2: Aesthetic Pleasure and Short-term Exercise Motivation

The primary research question of this study addressed the influence of aesthetic pleasure on the motivating capability of motivational text messages on short-term exercise motivation. For this purpose, a 3*3 factorial design was created where perceived motivating levels of the text messages and the aesthetic pleasure of their visual presentation were manipulated. To try to achieve the three levels of motivation of the text messages—perceived motivating, neutral, and not-motivating—we started by creating a pre-study where 26 messages were assessed regarding their motivating capability. To try to achieve the three levels of the aesthetic pleasure—perceived beautiful, neutral, ugly—we started by creating a pre-study where 18 visual presentations were assessed regarding aesthetic pleasure. From the results of these two pre-studies, we then created the pool of visual quotes used in the main experiment. After the experiment was conducted the results were classified accordingly to the perception of how motivating were the messages and their aesthetic pleasure. Next, we report the results of both pre-studies, and then we describe the main experiment.

3.2.1 Pre-study: Text Messages

A list of 26 text messages was collected from the Instagram account of the activity tracker Runkeeper [129]. We reviewed the posts from last to first until 26 generic text messages that do not refer to a brand or associated services were identified. Participants were recruited through Amazon Mechanical Turk [4]. Qualification requirements were defined: the number of HITs (tasks) approved greater than 500, and a HIT approval rate greater than or equal to 99%. Each individual was compensated with $.50. 100 individuals were recruited, but due to non-US nationalities, two individuals dropped out, which left 98 valid participants. Participants were asked to assess the 26 messages following a 7-item Likert scale, ranging from extremely

motivating (1) to extremely demotivating (7), and the images were presented randomly, one at a time. After, participants were asked some questions related to their personal characterization (age, gender, nationality, education, exercise habits, and habits of seeing motivational text messages).

Results. The majority of the participants were women (71%), which might have led to gender bias. The sample's median age was 38 years (minimum = 20 years and maximum = 65 years or older). All participants have at least a high school education. Most of the participants reported exercising once in a while (42%), or never exercising (29%). Lastly, participants did not encounter motivational text messages related to physical exercise often. Only 6% of the participants reported encountering messages frequently. 31% of the participants reported seeing motivational text messages sometimes, 40% rarely, and 23% declared never encountering motivational messages. None of the messages were considered demotivating considering the mean of assessments. Therefore, we picked three messages assessed as neutral (*Did you get your dose today?* Mean=4.3, Standard Deviation=1.2; *How did you move today?* M=4.0, SD=1.0; *What do you run for?* M=3.7, SD=1.3), three messages assessed as slightly motivating (*Find your motivation.* M=3.4, SD=1.3; *Embrace the road in front of you.* M=3.0, SD=1.2; *Find your inspiration gear up and go.* M=2.9, SD=1.2), and three messages assessed as moderately motivating (*Let nothing stand in your way.* M=2.4, SD=1.2; *There's no feeling like exceeding your own expectations.* M=2.2, SD=1.0; *No matter what your goals are, the first step is to start.* M=2.1, SD=1.1).

3.2.2 Pre-study: Aesthetic Pleasure

To create variation regarding the aesthetic pleasure, several visual presentations were created and tested with 11 participants. Following the results of these exploratory assessments, a pool of 18 visual presentations was selected to be assessed in the pre-study, which showed potential variety regarding aesthetic pleasure levels and would present relative agreement in the results among participants. In all visual presentations was used as text the anagram: *The quick brown fox jumps over the lazy dog*. A total of 195 individuals were recruited through Amazon Mechanical Turk and had received a compensation of $.50. Some individuals did not pass the criteria of having US nationality (n=8), which left a total of 187 valid participants. Participants were asked to assess 6 (out of the 18) randomly selected visual presentations. Visual presentations were presented one at a time. The aesthetic pleasure was measured by applying the validated scale Aesthetic Pleasure in Design [11]. Next, participants were asked to answer some demographic questions (age, gender, nationality, level of education). *Results.* The percentage of men and women participating in the study was relatively similar. 54% of the participants were men, and 46% were women. The

sample's median age was 31 years (minimum = 19, maximum = +65). Almost half of the participants 42% reported having a bachelor's degree, and only two participants reported having less than a high school education. Each visual stimulus was assessed on average 62 times. Following the results of the aesthetic pleasure assessments, nine visual stimuli that varied regarding aesthetic pleasure levels were selected to be used in the pool of the main experiment. They were, the three visual stimuli assessed as the ugliest, three assessed as neutral, and the three assessed as more beautiful (assessed as slightly positive regarding aesthetic pleasure). Table 3.2 presents the means scores of aesthetic pleasure and standard deviations obtained for each of the visual stimuli selected, and Table 3.3 displays the correspondent visual presentations already with the text messages applied in the main experiment.

Table 3.2: Means and standard deviations of the aesthetic pleasure assessments of the visual stimuli selected to be used in the main experiment (scale values ranged from -3 [extremely ugly] to 3 [extremely beautiful]). The letter followed by a number corresponds to the visual presentation displayed in Table 3.3.

	Mean (Standard deviation)		
Ugly	A1 -1.93 (1.48)	B1 -1.89 (1.62)	C1 -0.90 (1.59)
Neutral	A2 0.06 (1.36)	B2 0.47 (1.31)	C2 0.48 (1.37)
Beautiful	A3 1.14 (1.17)	B3 1.19 (1.30)	C3 1.19 (1.27)

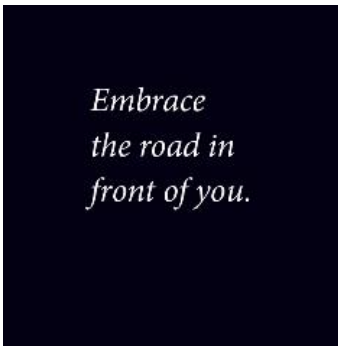
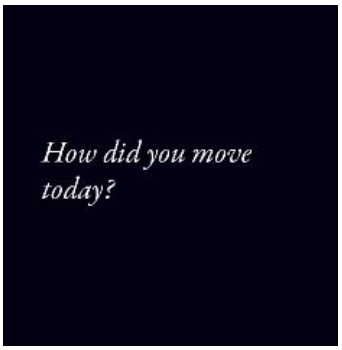
3.2.3 Main Experiment

The main goal of the experiment was to understand how aesthetic pleasure influences the motivating capability of motivational text messages on identified behavior regulation. *Material.* A pool of nine visual quotes was created following the results of the two pre-studies described previously. Table 3.3 shows the pool of visual stimuli used in the main experiment. The visual presentations were displayed to participants in the size of 600*600 pixels.

Participants. 400 participants were recruited through Amazon Mechanical Turk and were compensated with $.40. To participate in the study individuals had to pass some qualification requirements: location equal to the US, a number of HITs (tasks) approved greater than 500, and a HIT approval rate greater than or equal to 99%. The data obtained from participants were

filtered by nationality and repetition of the IP address. Data from participants with nationality different from the US (n=9) and data entries with a repeated IP address (n=4) were removed, which left a total of 387 valid participants.

Table 3.3: The pool of visual stimuli used in the experiment. Column A: slightly motivating messages; Column B: neutral messages; Column C: moderately motivating messages. Row 1: ugly visual presentations; Row 2: neutral visual presentations; Row 3: beautiful visual presentations.

	A	**B**	**C**
1			
2			
3			

Procedure. One of the visual stimuli picked randomly from the pool was presented to the participant. The participant was asked to assess this visual stimulus (visual quote) regarding

aesthetic pleasure, using the validated scale Aesthetic Pleasure in Design [11], and its perception about how motivating or demotivating he/she found the text message presented in a 7-point item Likert scale. Next, the identified behavior regulation was measured using the BREQ-3 scale [173], followed by some demographic questions.

3.2.4 Results

60% of the participants were male, and 40% female. The sample's median age was 31 years (minimum = 18, maximum = 65), and all participants reported having at least a high school education. Most of the participants were regular exercisers. Only 21% of the participants reported exercising just once in a while, and 5 % reported never exercising. Since we were interested in the effect of perception, participants were classified according to their assessment scores regarding aesthetic pleasure and motivational capability of textual messages (Table 3**.4**).

As we can see in Table 3**.4**, only 19 participants classified messages as not being motivating. This result was expected because, during the pre-study of the text messages, not one of the messages were assessed as demotivating. Due to the small size of the groups within this level of messaging (Table 3**.4**, row demotivating), we decided not to conduct statistical analysis on these results and therefore discarded these results. A 2 x 3 factorial design was therefore obtained.

The independent variables are: textual content perception with two conditions (motivating, and neutral), and aesthetic pleasure perception with three conditions (beautiful, neutral, and ugly).

Table 3.4. The number of participants within each condition.

		Aesthetic pleasure perception			
		Beautiful	***Neutral***	***Ugly***	*Total*
Textual content perception	***Motivating***	54	27	26	107
	Neutral	50	84	127	261
	Demotivating	2	4	13	19
	Total	106	115	166	387

To determine if there is an interaction effect between the perceived motivating capability of motivational text messages and the aesthetic pleasure on the continuous variable identified behavior regulation, we ran a two-way ANOVA. However, due to the non-normal distribution

we decided on separate Kruskal-Wallis tests. Two Kruskal-Wallis H tests were ran instead, however these tests did not allow for the interactions effects to be examined.

Two research questions were asked. RQ1: Does aesthetically appealing visual presentations influence the motivating capability of perceived motivating messages in identified behavior regulation? RQ2: Does aesthetically appealing visual presentations influence the motivating capability of perceived neutral messages in identified behavior regulation? To answer RQ1, we focused on group differences of aesthetic pleasure within the level of motivating text messages.

The independent variable was the variable aesthetic pleasure that had three conditions: beautiful, neutral, and ugly. The dependent variable was the continuous variable identified behavior regulation measured using the BREQ-3 scale [173]. Due to the nature of the project being related to perception, we were not able to control how many participants would have each condition or group. The Beautiful group had 54 individuals, the Neutral group had 27 individuals, and the Ugly group 26 individuals for a total of 107 participants (Table 3**.4**, the row of the motivating messages). Data were not normally distributed in all cells. Therefore, a non-parametric test was performed to examine the group differences in identified behavior regulation. A Kruskal-Wallis H test was run to determine if there were differences in identified behavior regulation scores between the three groups of perception of aesthetic pleasure: the "Beautiful" (n= 54), "Neutral " (n= 27), and "Ugly" (n=26). Distributions scores were somewhat similar for all groups, as assessed by visual inspection of a boxplot. Median identified behavior regulation scores (beautiful = 4.25, neutral = 3.75, ugly = 4.25) were not statistically significantly different between the groups, $\chi 2(2) = 4.166$, $p = .125$.

To answer RQ2 we focused on group differences of aesthetic pleasure within the level of neutral text messages. The independent variable was the variable aesthetic pleasure that had three groups: beautiful, neutral, and ugly. The dependent variable was the continuous variable identified behavior regulation. The Beautiful group had 50 individuals, the Neutral group had 84 individuals, and the Ugly group 127 for a total of 261 participants (Table 3**.4**, the row of the neutral messages). Data were not normally distributed in all cells. Therefore, a non-parametric test was performed to examine the group differences in identified behavior regulation. A Kruskal-Wallis H test was run to determine if there were differences in identified behavior regulation scores between the three groups of perception of aesthetic pleasure. Distributions scores were similar for all groups, as assessed by visual inspection of a boxplot. Median identified behavior regulation scores (beautiful = 3.87, neutral = 3.50, ugly = 4.00) were not statistically significantly different between the groups, $\chi 2(2) = 5.148$, $p = .076$.

3.2.5 Discussion and Limitations

Human-computer interaction literature is inconclusive regarding the impact of aesthetic pleasure (aesthetic appeal) in other factors related to user experience. While early studies found that visual aesthetics can impact the perception of the usability of interactive systems [93, 154, 156], more recent studies have questioned these findings and did not always find a correlation between aesthetics and usability [67, 71, 140]. In general, there is a relative agreement about visual aesthetics contributing positively to the overall experience with an interactive system.

In this study, we were interested in exploring whether perceiving a visual presentation of a motivational text message as beautiful will strengthen the motivating capability of the message on short-term exercise motivation (in the extrinsic identified behavior regulation). Our results suggest that aesthetic pleasure does not influence the motivating capability of perceived motivating or neutral motivational text messages on identified behavior regulation.

Following the literature, this does not necessarily mean that aesthetic pleasure cannot contribute to an overall positive feeling regarding the text message, but instead that aesthetic pleasure did not strengthen the motivating capability of the textual content in the type of exercise motivation linked to short-term exercise (extrinsic identified behavior regulation).

For future studies, we suggest exploring the interaction effects between the perceived motivating capability of the textual content and aesthetic pleasure. One factor could interact with the other. In the context of activity tracking our findings mean that delivering motivational text messages as notifications (text-only) or as visual quotes (embedded in a visual presentation) can have the same impact in exercise motivation. We note, however, that we did not study the impact of using imagery in the visual presentations of motivational text messages. One of the limitations of our study was due to its nature of studying perception. Since we did not know, although we had conducted pre-studies, how many individuals would assess the visual presentations as Beautiful, Ugly, or Neutral, we were not able to define from the beginning of the study the number of participants in each condition. This resulted in different group sizes. Finally, it can be argued that some visual presentations used did not differ much from each other. As such, the finding that perceived beauty does not have an impact could be caused by that. However, we highlight that our results are in line with another very recent similar study [48].

3.2.6 Conclusion

Nowadays, it is quite common to encounter motivational text messages embedded in a visual presentation. This paper explored whether the aesthetic pleasure perceived from these visual presentations impact the motivating capability of motivational text messages on exercise

motivation. Our experiment discovered that, opposite to what may be expected, aesthetic pleasure might not strengthen the motivating capability of perceived motivating and neutral text messages on exercise motivation. Further research is needed to study the influence of the visual dimension of visual quotes on exercise motivation and engagement with physical activity tracking to help to understand how they can leverage healthy behavior changes.

4

Text Message Design and Its Influence on Aesthetic Pleasure Power

This chapter explores different ways of framing text messages and the impact of aesthetic pleasure on their motivating capability.

4.1 Study 3: Positively Versus Negatively Framed Text Messages and their influence on exercise motivation

The goal of this study was to explore how aesthetically appealing visual presentations impact the motivating capability of positive-framed text messages in the context of physical activity.

The study focused on how alterations in the perception of beauty impact the assessment of textual content. Since we were interested in the effect of perception, we were unable to confirm before the start of the study whether the participants would perceive a certain visual presentation as beautiful, neutral, or ugly, and thus assign them to conditions.

Therefore, participants started by being randomly assigned to one of the visual stimuli, presented in Table 4.1 (to A.1, A.2, B.1, or B.2). After data analysis, participants that received the stimulus A.1 or A.2 were assigned to condition a) no-aesthetics.

Participants who received the stimulus B.1 or B.2 were split considering their assessment of aesthetic pleasure regarding the visual stimulus. Participants assigned to stimulus B.1 or B.2 who assessed the visual presentation as positive regarding aesthetics were assigned to condition b)

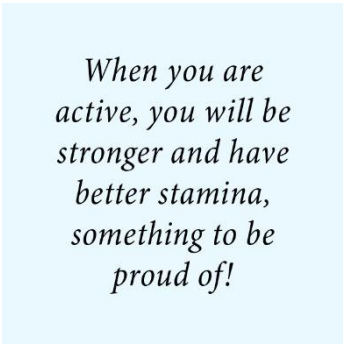
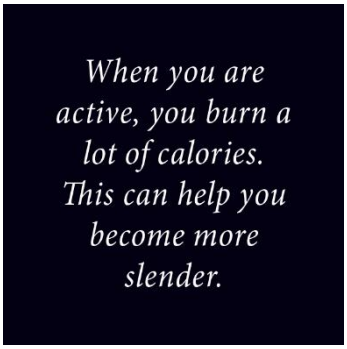
positive aesthetics, and participants who assessed the visual presentation as negative regarding aesthetics were assigned to condition c) negative aesthetics.

The target population of this study was sedentary young adults. To reach the target population, the survey started with a closed-ended screening question regarding exercise habits: "Which statement best describes how often you exercise?" Participants were invited to participate in the study if their answer was "I never exercise." Individuals who reported doing some physical activity were disqualified from the study.

Procedure and measurements. First, participants were asked to assess how motivating or demotivating they found the message presented to them on a Likert-scale (7-point, from extremely demotivating to extremely motivating).

Participants that received the stimulus B.1 or B.2 were after asked to assess the aesthetic pleasure from the visual presentation using the Aesthetic Pleasure in Design scale [11].

Table 4.1: Stimuli used in the experiment.

A - POSITIVE FRAMED MESSAGES
A.1. When you are active, you burn a lot of calories. This can help you become more slender.
A.2. When you are active, you will be stronger and have better stamina, something to be proud of!
B – POSITIVE FRAMED MESSAGES WITH AESTHETICS
B.1.  B.2. 

Next, the identified behavior regulation in all cases of participants was measured using BREQ-3 scale [103, 173], ending with demographic questions (age, gender, nationality, education).

Material. The messages used in the study were extracted from the appendices of a study by Riet and colleagues [162] that investigated message-framing effects in the context of a tailored intervention promoting physical activity.

In their study, the conclusions showed that gain-framed messages resulted in stronger intentions to be physically active than loss-framed messages.

The visual presentations were created by us and were selected based on the results of exploratory pre-studies (with between eight to eleven participants), where several different visual presentations were presented to participants who were asked to assess the visual presentation regarding aesthetic pleasure using the Aesthetic Pleasure in Design scale [11].

Participants. Participants were recruited using Amazon Mechanical Turk, and all of them had a HIT (tasks) approval rate greater than 99%. Each participant was compensated with $0.40. The time assigned to the task was 4 minutes, and participants took on average 76 seconds (standard deviation = 61 seconds) to answer to the questionnaire. One hundred and nine individuals passed the screening question by reporting that they never exercised, and thus were invited to participate in the study. 109 sedentary adults participated in the experiment. Due to nationality outside of the US, 12 individuals were disqualified from the study, leaving a total of 97 participants.

4.1.1 Results

Participants characterization. 38 of the participants were men (39 %) and 59 were women (61%). The sample's median age was 30 years (min. = 18, max. = 60). Around half of the participants held a bachelor's degree (51%) followed by 19% holding a graduate or professional degree. The percentage of participants with an associate degree (11%) was the same as those who reported having some college but no degree. Around 5% of the participants reported being high school graduates (including equivalency). Only 2% held a Ph.D. and only 1% of the participants had less than a high school degree.

Aesthetics assessment. In Figure 4.1 we show a histogram with the aesthetic pleasure assessment values. The majority of the assessments of the visual presentation were positive or negative, following the Aesthetic Pleasure in Design scale [11], with 0 being extremely ugly and 7 being extremely beautiful. Three conditions were created from the results.

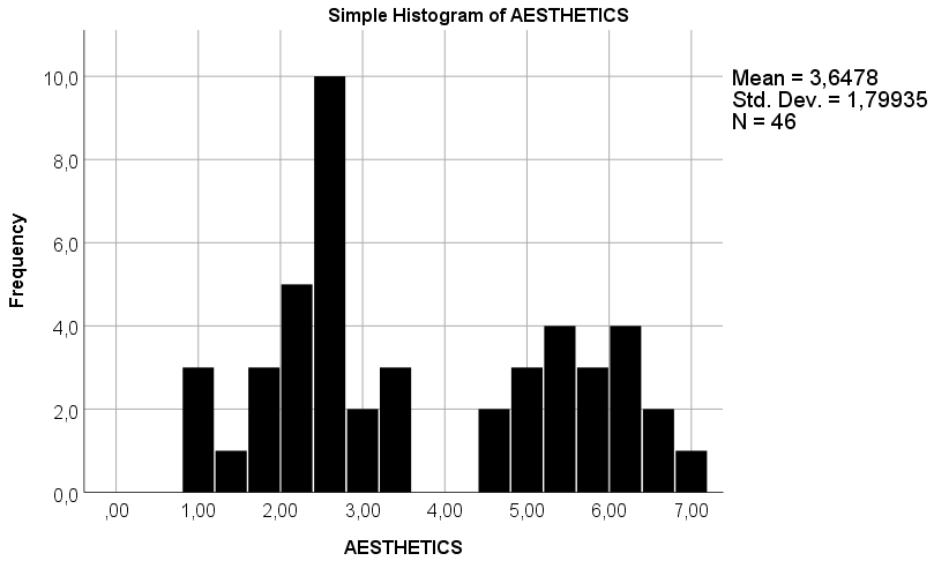


Figure 4.1: Histogram of aesthetics assessment scores.

Final conditions of the study. The three final conditions of the study were: (a) no-aesthetics (text-only messages), (b) positive aesthetics, and (c) negative aesthetics. 51 participants were assigned to condition (a), 27 to condition (b), and 19 to condition (c).

4.1.1.1 Research Questions

The main research question answered in this study was, "How do visual aesthetics influence the motivating capability of positive-framed text-messages?" To answer this question, we divided it into two sub-questions.

RQ1: Is there a difference in perceiving how motivating a positive-framed text message is according to its visual presentation: (a) as text-only, (b) embedded in perceived aesthetically appealing visual presentations, and (c) embedded in perceived aesthetically unappealing visual presentations?

RQ2: Is there a difference in the impact of positive-framed text messages in the extrinsic identified behavior regulation according to the message's visual presentation: (a) as text-only, (b) embedded in perceived aesthetically appealing visual presentations, and (c) embedded in perceived aesthetically unappealing visual presentations?

4.1.1.2 Research Question 1 Results

To answer research question 1, in which there was an ordinal independent variable (with three aesthetics categories), and an ordinal dependent variable (how motivating is the message, measured on a 7-point Likert scale), a rank-based nonparametric Kruskal-Wallis H test was conducted.

A Kruskal-Wallis H test was performed to determine if there were differences in how the message was perceived as motivating between three groups of participants that differed in their levels of aesthetic pleasure: the "text-only visual presentation" (n=51), "positive aesthetics" (n=27) and "negative aesthetics" (n=19) level groups.

Distributions of aesthetic pleasure scores were not similar for all groups, as assessed by visual inspection of a boxplot (

Figure 4.2). The mean rank of aesthetic pleasure scores was not statistically significantly different between groups, $X^2(2) = 0.033$, $p = .984$.

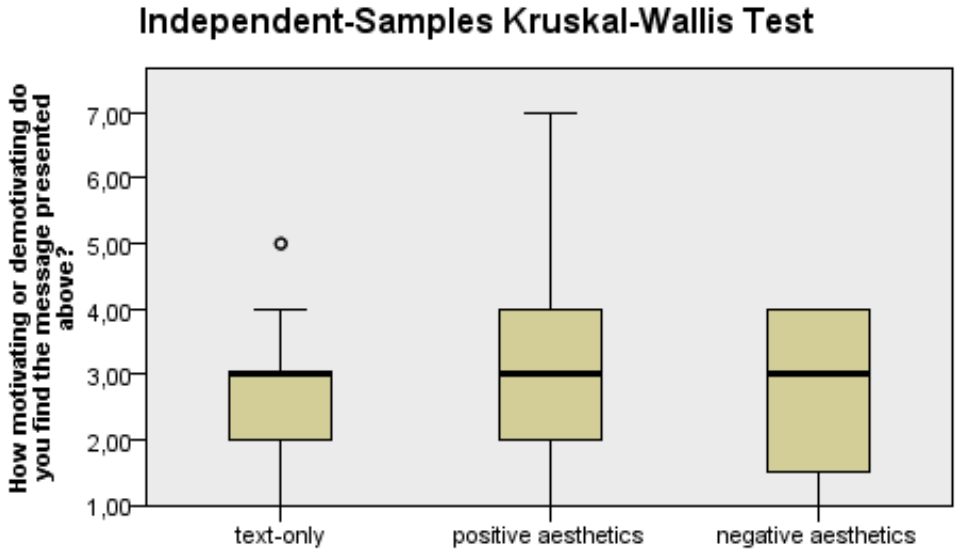


Figure 4.2: Distributions of aesthetic pleasure scores in each condition.

4.1.1.3 Research Question 2 Results

Question 2 investigated if there were statistically significant differences between three groups of an independent variable (aesthetic pleasure) on a continuous dependent variable (extrinsic identified behavior regulation following the scale BREQ-3 [103, 173]).

To test this, the Kruskal-Wallis H test, a rank-based nonparametric test, was carried out.

The Kruskal-Wallis H test was performed to determine if there were differences in extrinsic identified behavior regulation score between three groups of participants with different aesthetic pleasure: the "text-only," "positive aesthetics," and "negative aesthetics" level groups.

Distribution of extrinsic identified regulation was similar for all groups, as assessed by visual inspection of a boxplot (

Figure 4.3).

Median extrinsic identified regulation scores were not statistically significantly different between groups, $X^2(2) = 2.245$, $p = .325$.

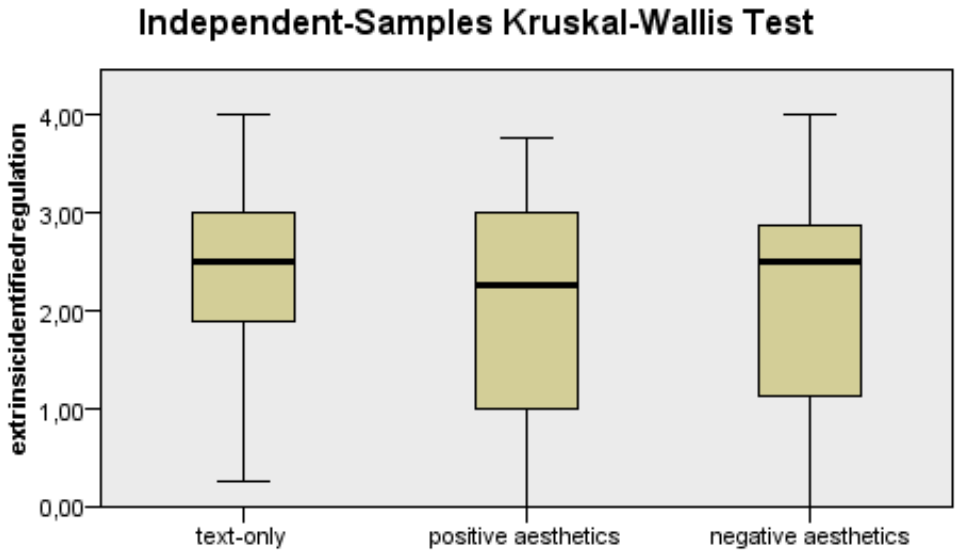


Figure 4.3: Distributions of extrinsic identified behavior regulation scores in each condition.

4.1.2 Discussion, Limitations, and Conclusion

Visual aesthetics (the beauty or pleasing appearance of things) can influence users' perception of product attributes, such as usability [156]. However, while nowadays many people see motivational text messages embedded in a visual presentation [23, 31], HCI studies related to motivational text messages have not studied the impact of the visual aesthetics dimension on the motivating capability of motivational text messages. This study was focused on studying the impact of the perception of beauty and ugliness on the motivating capability of positive-framed text messages in the context of physical activity.

Results showed that, independently of perceiving a visual presentation as beautiful or ugly, the visual aesthetics did not impact subjects' assessment of positive-framed text messages' motivating capacities. Moreover, perceiving a visual presentation as beautiful or ugly also did not change the motivating capability of positive-framed text messages presented as text-only in the extrinsic identified behavior regulation [157]. These results were not expected due to the positive effects reported by studies regarding the influence of visual aesthetics in the general evaluation of products [99, 141, 155].

The main limitation of the study was the nature of studying perception; it was not possible to assign the subjects of the study to all defined conditions beforehand, since we did not know who

or how many participants would perceive a visual presentation as beautiful or ugly. Therefore, participants were assigned to conditions only in the data analysis. Another significant limitation was the number of participants on each condition, which researchers could not fully control.

In conclusion, according to our study, aesthetically appealing visual presentations do not impact the perceived motivating capability of positive-framed messages directly. Assuming users of activity tracking services would be looking for a boost of extra motivation, the presence of aesthetically appealing visual presentations would not impact their perception regarding how motivating the text messages are. The development of the textual content in this scenario is a crucial part of a product feature focused on providing motivational text messages to impact the exercise motivation of individuals. On the other hand, it remains undetermined as to whether aesthetic appeal can help activity tracking services, in terms of engaging their users with this kind of feature. In other words, it is possible that aesthetic appeal can help to instigate a positive feeling regarding the text over time. Regarding future work, we note that this study did not explore the impact of using imagery as background in the visual presentations of motivational text messages, it may be that imagery (as part of the visual dimension of the visual presentation of motivational text messages) has an impact in exercise motivation.

4.2 Study 4: Self-Liberating Text Messages

In this study, we contribute with an online experiment in which individuals received messages over several days to understand whether the perception of aesthetic pleasure improves the motivating capability of encouraging text messages in the short-term. We finish by discussing our results and implications for the design of digital mHealth tools focused on delivering text messages.

We designed a 5-day online experiment to explore and compare how differences in the visual presentation of motivational text messages influence the motivational power of the textual content. We compared text-only presentations against typographic presentations. Moreover, we were particularly interested in examining the influence of the perception of aesthetic pleasure from text presentation in the motivational capability of the textual content of the message.

We specifically investigated the following research questions:

RQ1: Is there a difference in how motivating is perceived a text message between text-only and typographic presentations?

RQ2: Is there a difference in how motivating is perceived a text message based on aesthetic pleasure (from its presentation)?

RQ3: Is there a difference in short-term exercise motivation (identified behavior regulation) amongst individuals who perceived on average [negative | neutral | positive] aesthetic pleasure five days after a text-based message intervention?

4.2.1 Methods

To answer to research question one, we started by designing five stimuli for each condition, text-only and typographic compositions. Figure 4.4 and Figure 4.5 illustrate the visual stimuli created for each visual presentation condition. Text messages used in the visual stimuli were developed by Vries and et al. [165, 167], assessed as slightly motivating and derived from transtheoretical model of behavior change [165].

Table 4.2 characterize and presents the specificities of text messages (textual content). The visual presentations were specifically created for this experiment.

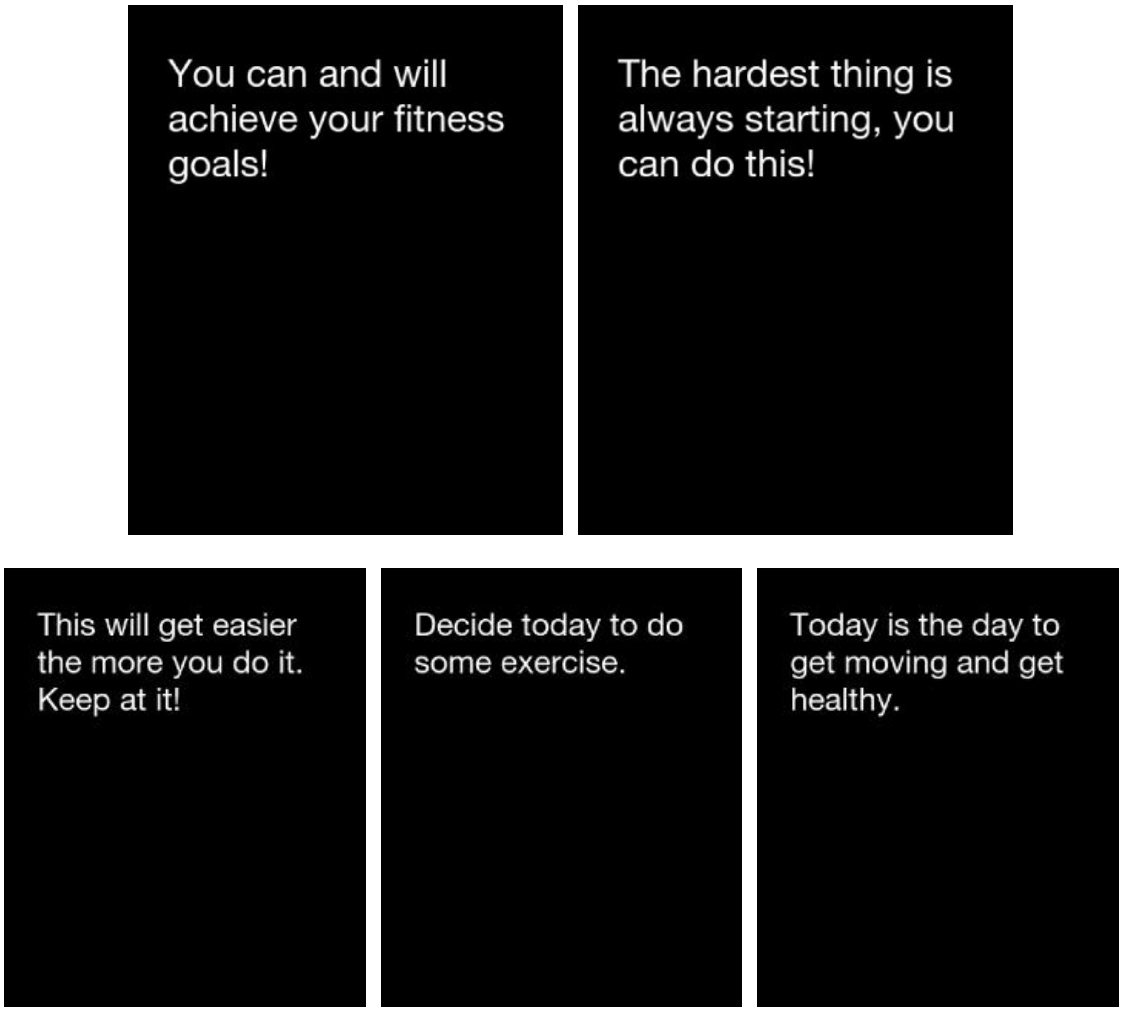


Figure 4.4: The five visual stimuli of the condition text-only.

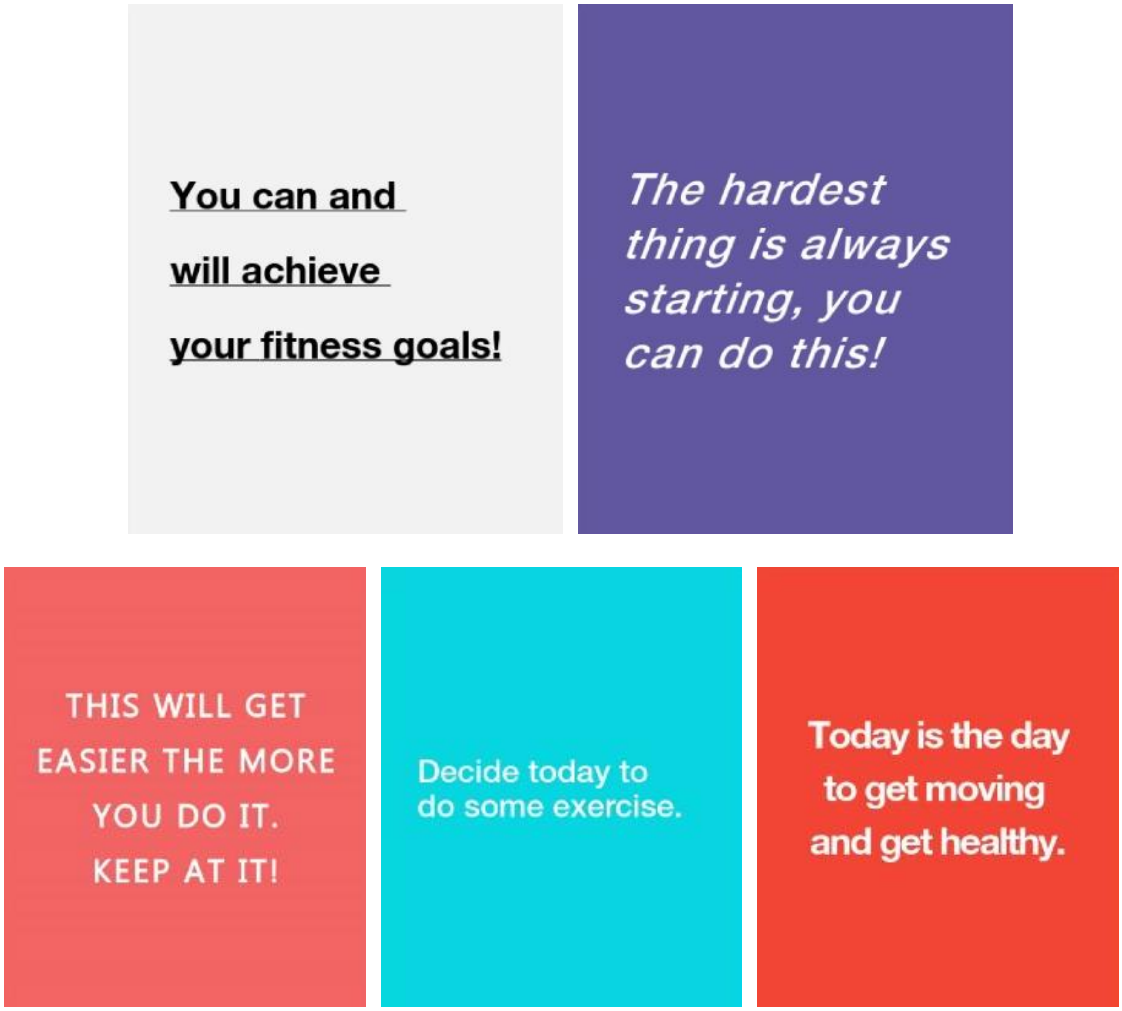


Figure 4.5: The five stimuli of the condition typographic presentations.

In the text-only condition, all text messages were embedded in a black background, and this condition worked as a control group. As opposite, the visual presentations in condition typographic compositions varied regarding background colors, typefaces, and typefaces styles.

Each participant was randomly assigned to one of the conditions. Each day each participant was exposed to a visual stimulus randomly picked from the visual stimuli pool of the condition assigned to him/her, and that has not been presented to the participant in previous days. We recruited 50 participants through the crowdsourcing platform Prolific (www.prolific.ac). Some studies have shown that Prolific platform has a more honest audience compared to other relatively popular platforms, such as Amazon Mechanical Turk [120, 121]. A particular feature of this platform is that it requires a minimum compensation of five pounds per hour to participants.

Table 4.2: Characteristics of the textual content of the text messages applied (coded as self-liberating/committing yourself following the transtheoretical model of behavior change). Figure derived from Vries [165] page 124.

Process
Self-Liberation/Committing yourself (SEL)
Brief Definition
The choice and commitment to change in being physical active and also believe in it.
Full Definition
SEL is a process that helps individuals in their choice and commitment to be physical active and their believe to stay active.
Practical Definition
Encourage the subject to make (and keep) promises, plans, and commitments to yourself to be active on short term (mostly behavioral process and a bit cognitive process)
Perspectives
To start/trigger the process: messages that instigate you to make a commitment (to someone/yourself) or set a goal for exercise or messages that drive you to accept responsibility for starting to exercise. To advance the process: messages that help and remind you of your commitment (to someone/yourself) or your goal for exercise. To distinguish: Perspective is usually on a short-term goal.
Inclusion
Start exercise: keywords like that say “goal” or “commitment”; Keep exercising: “don’t give up”, “you can do it”, “stay motivated” etc. or paraphrases of this.
Exclusion
Sentences where the “don’t give up” and others are just ‘added’ and not the main topic
Example of Inclusion
“Don’t give up, you can do it”; “Keep it up!”; “Keep going”
Example of Exclusion
“Don’t give up, you’re dreams about to come true” – would fit better in the process reinforcement management/rewarding yourself because of the (future) reward being the most important part of the message; “Get up and do it” – it contains no commitment of promise, so it fits better in the process stimulus control/reminding yourself.

At the beginning of the study, it was explained to participants: a) the general goal of the study, b) how many days the full experiment would take, and c) how much they would be compensated by participating in each day of the study (Table 4.3). Lastly, the bonus they would receive if they participated in the five days of the study (£1.50).

Participants were screened by nationality (the United Kingdom) using the platform. Like what Prolific platform announces in its website about what is the percentage of participants typically dropping out in longitudinal studies (between 0 and 50%), we had a rate of 48% of participants dropping out over the days (most of them in the second day, 34%). In the end, on the fifth day, we had a total of 26 participants, which data was analyzed.

Table 4.3: What was measured and how much was paid in each day of the experiment.

Days	**Time Assigned**	**Payment**
Day 1	***5 min***	***£0.50*** [1]
- Prolific ID - BREQ-3 [103, 173] (assess types of exercise motivation) - x1 stimulus (copy message, assess how motivating the message is, aesthetic pleasure design scale [11])		
Day 2	***2 min***	***£0.25*** [2]
- Prolific ID - x1 stimulus (copy message, assess how motivating the message is, aesthetic pleasure) - Demographic questions (exercise habits, messages view frequency)		
Day 3	***2 min***	***£0.25***
- Prolific ID - x1 stimulus (copy message, assess how motivating the message is, aesthetic pleasure) - Demographic questions (gender, nationality)		
Day 4	***2 min***	***£0.25***
- Prolific ID - x1 stimulus (copy message, assess how motivating the message is, aesthetic pleasure)		
Day 5	***5 min***	***£0.50 + £1.50 bonus***
- Prolific ID - x1 stimulus (copy message, assess how motivating the message is, aesthetic pleasure) - BREQ-3 (assess types of exercise motivation)		

[1] correspondent to six pounds per hour; [2] correspondent to seven pounds and half per hour

4.2.2 Results

The majority of the participants were female (Table 4.4, line gender). Participants were between 21 and 48 years old, and the number of participants in each age group was relatively similar (Table 4.4, line Age).

Regarding education, 39% of the participants had a bachelor's degree, followed by 19% that was high school graduate and 42% other education levels (Table 4.4, line Education).

Participants had different exercise habits, ranging mainly between doing exercise in a while and "very often " (more than three times a week) (Table 4.4, line Exercise Habits).

More than half of the participants reported sometimes seeing motivational text messages (58%) (Table 4.4, line Messages frequency).

Table 4.4: Participants characterization.

Gender 22 female (85%), 4 male (15%)
Age min 21, max 48, mean ~33, median 31 10 21-29, 8 30-39, 8 40-48
Education 2 less than high school, 5 high school graduate includes equivalency), 4 some college no degree, 1 associate's degree, 10 bachelor's degree, 4 graduate or professional degree
Exercise habits 2 never exercise, 5 once in a while, 4 once a week, 5 twice a week, 4 three times a week, 6 more than three times a week
Frequency of seeing messages 6 never, 4, rarely, 15 sometimes, 1 frequently

4.2.2.1 How Motivating Is Perceived a Message in Text-only Vs. Typographic Presentations

To determine if there are differences between text-only and visual presentations on the perception of how motivating is a text message (research question 1), we run the rank-based nonparametric Mann-Whitney U test. The control condition C (text-only presentation) had 12 participants, and the condition A (aesthetic/visual presentations) had 14.

Distributions of the perception of how motivating are the messages for text-only and aesthetics/visual presentations were relatively similar, as assessed by visual inspection (

Figure 4.6).

How motivating is the messages' score was not statistically significantly different between text-only presentations (Mdn= 3) and aesthetics/visual presentations (Mdn= 2), U= 110.500, z= 1.499, p= .176 using an exact sampling distribution for U.

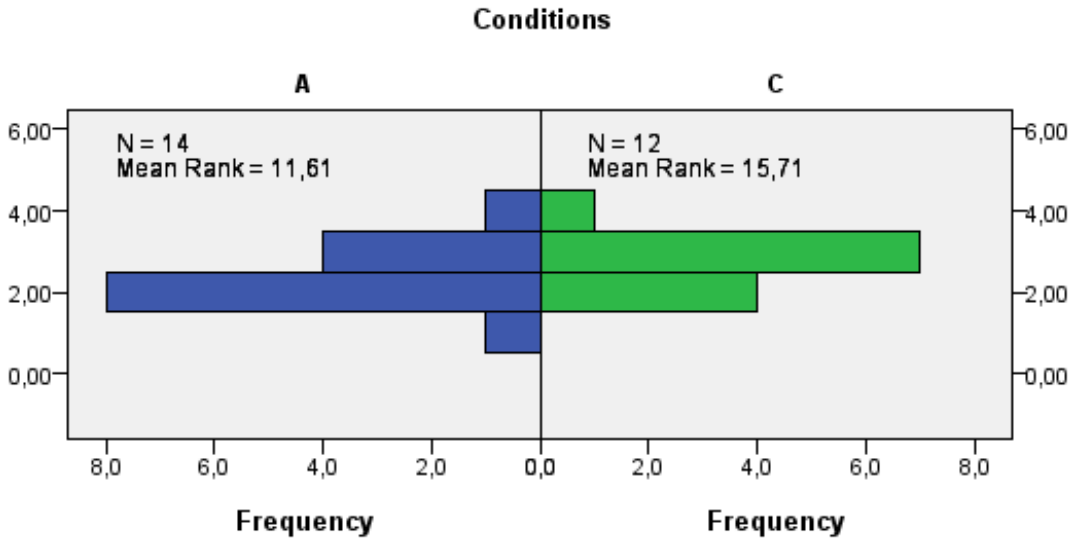


Figure 4.6: Mann-Whitney U test (frequencies). Condition A corresponds to aesthetic/typographic presentations. Condition C corresponds to text-only presentation.

4.2.2.2 How Motivating is Perceived a Text Message Based on Aesthetic pleasure

To answer to research question two, we started by categorizing participants' scores of perceived aesthetic (measured through the scale Aesthetic Pleasure in Design [11]) in three general levels of aesthetic pleasure: negative, neutral, and positive.

(The negative level encompassed the scores between 1 and 3.4; The neutral level included the scores between 3.5 and 4.4; The positive level contained the scores between 4.5 and 7).

We run a Kruskal-Wallis H test to understand whether the perception about how motivating messages are, measured using an ordinal scale (a seven-point scale from "strongly agree" to "strongly disagree"), differed following the perception of aesthetic pleasure levels: negative (n= 7), neutral (n= 9), positive (n= 10).

Distributions of how motivating messages are perceived scores were not similar for all groups (Figure 4.7).

The mean ranks of how motivating messages scores are were not statistically significantly different between groups, x^2 (2)= 3.415, p= .181.

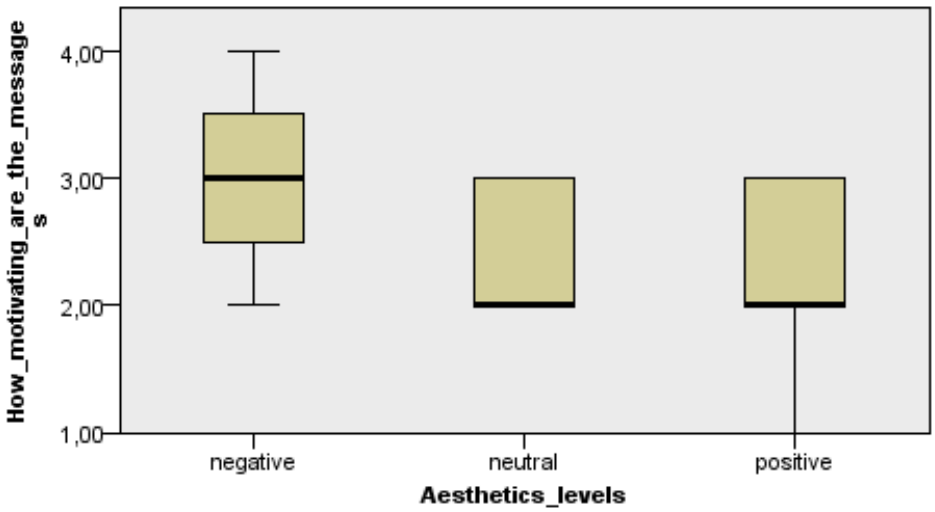


Figure 4.7: Distributions of how motivating messages were perceived following the aesthetic pleasure levels.

4.2.2.3 The Influence of Aesthetic Pleasure in Exercise Motivation

The goal of research question three was to understand whether there was a difference in identified behavior regulation within each aesthetic pleasure level before and after the intervention of five days.

For each aesthetic pleasure level, we run a Wilcoxon signed-rank test to determine if there was a median difference in participants' exercise motivation before and after the five days of seeing the text messages.

Negative Aesthetic Pleasure Level. Of the 7 participants in the negative aesthetic pleasure group, the aesthetic pleasure elicited an improvement in exercise motivation in three participants. It elicited a diminishment in exercise motivation in three participants, and no alteration in one participant (Figure 4.8).

A Wilcoxon signed-rank test determined that there was no statistically significant median decrease in identified behavior regulation when subjects were subject to negative aesthetic pleasure. (Pre-median= 4.50, post-median= 4.25) Z= .33, p = .739.

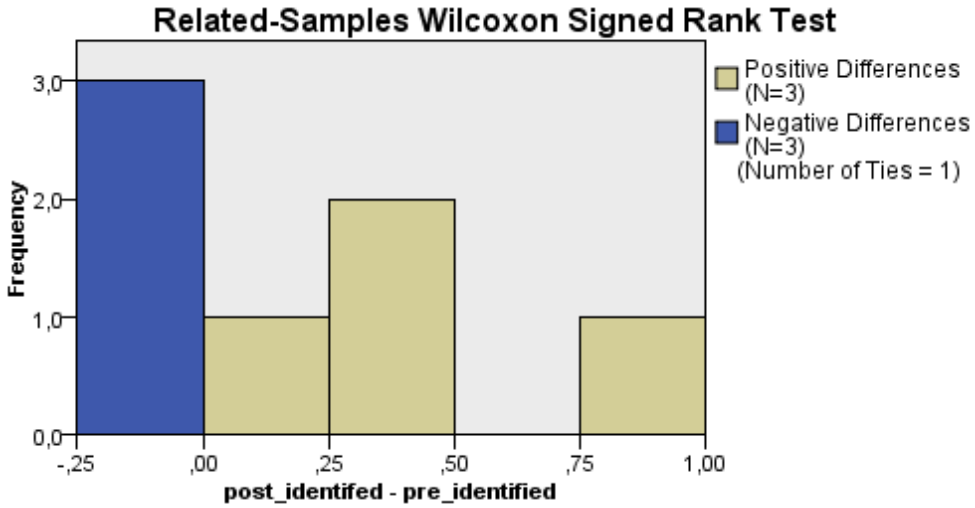


Figure 4.8: Differences between pre- and post-identified regulation within the negative aesthetic pleasure level.

Neutral Aesthetic Pleasure Level. Of the 9 participants in the neutral aesthetic pleasure group, the aesthetic pleasure elicited an improvement in exercise motivation in three participants. It elicited a diminishment in exercise motivation in four participants, and no alteration in two participants (Figure 4.9). A Wilcoxon-signed rank test determined that there was no statistically significant median decrease in identified regulation before and after subjects were exposed to neutral aesthetic pleasure. (Pre-median= 4.00, post-median= 3.75) Z= .51, p= .607.

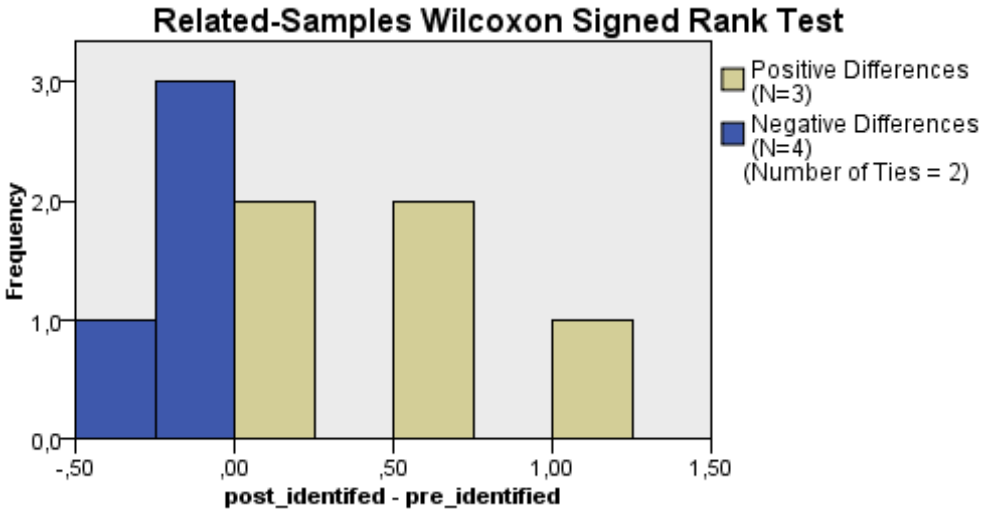


Figure 4.9: Differences between pre- and post-identified regulation within the neutral aesthetic pleasure level.

Positive Aesthetic Pleasure Level. Of the 10 participants in the positive aesthetic pleasure group, the aesthetic pleasure elicited an improvement in exercise motivation (identified

regulation) in four participants. It elicited a diminishment in exercise motivation (identified regulation) in two participants, and no alteration in four participants (Figure 4.10). A Wilcoxon-signed rank test determined that there was no statistically significant median increase in identified regulation before and after subjects were exposed to neutral aesthetic pleasure. (Pre-median= 3.25 post-median= 3.50) Z= .76, p= 4.50.

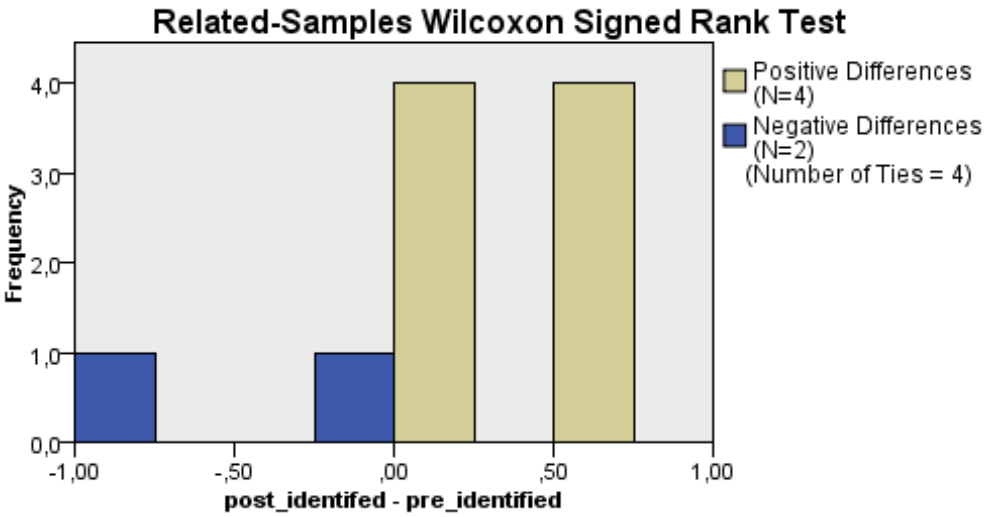


Figure 4.10: Differences between pre and post-identified regulation within the positive aesthetic pleasure level.

4.2.3 Discussion, Limitations, and Conclusion

While is now quite common to find motivational text messages embedded in a visual layout, as opposed to being presented "only" as body text, the influence of the visual layer (dimension) in the motivating capability of the textual content is not clear. Our previous experiments focused on the impact of aesthetic pleasure in the perception of how motivating is a text message found that there was no immediate effect on the motivating capability of the textual content of a motivational message [48–50].

In this study, we explored whether the same results were found when the individuals are exposed to visual stimuli over several days. The results found were similar to our previous studies. No influence could be found of aesthetic pleasure levels on the motivating capability of the messages. Messages were not perceived as more motivating when the visual presentation was assessed as positive regarding aesthetic pleasure, or less motivating when the visual presentation was assessed as negative.

We point as main limitations of this study, the small number of participants in each condition; The study may be gender-biased due to the underrepresentation, in terms of number, of men; It might happen that the context of the experiment itself may not reproduce well enough the conditions/context where and when usually individuals look for motivational text messages; Lastly, as we have as independent variable, the perception (of aesthetic pleasure), we cannot define a priori the number of people who would fall in the levels negative, neutral or positive aesthetic pleasure levels. For the design of digital apps, e-health apps focused on text messages, our results show the fact of a visual presentation (based on typographic compositions, not using images as background) being perceived as aesthetically appealing or unappealing do not influence the motivating capability of the text.

4.3 Study 5: Competence-focused Messages and the Number of Steps over Three Weeks

This study discusses how aesthetic pleasure influences the impact of competence-focused text messages on intrinsic motivation. The investigation is built upon the self-determination theory framework—specifically, on its mini-theory cognitive evaluation theory (CET) [133]. CET's primary concern is how events in the social environment (i.e., rewards, feedback, and other external events) impact intrinsic motivation. Specifically, this chapter addresses two major issues: (a) how aesthetic pleasure influences how motivating competence-focused text messages are perceived as being, and (b) how aesthetic pleasure influences the impact of text competence-focused messages in intrinsic exercise motivation. We finish by interpreting and translating the results to determine their meaning with respect to activity tracker services or digital apps that deliver encouraging text messages to their users.

4.3.1 Method

First, we conducted a pilot study to classify a list of text messages in terms of conveying competence (to use in the two central studies of the research). Next, we conducted the first main study, an online quasi-experiment, to understand the immediate effect of aesthetic pleasure on how motivating text messages are perceived as being. We then conducted a four-week short-longitudinal study to examine whether aesthetic pleasure influences the impact of text messages on intrinsic motivation over time, and on the number of steps.

4.3.2 Pilot Study: Classification of Text Messages

We gathered a list of 30 text messages from Instagram user *@runkeeper,* which is the account of the activity tracker service Runkeeper. We started with the most recent post, then continued back until we had identified thirty encouraging text messages. We then launched an online survey, recruiting 150 participants through the Prolific platform [120, 121]. Participants were pre-screened by nationality (UK). For participating in our study, the individuals received a monetary reward corresponding to £7.80 per hour. (The time assigned to the task was three minutes, for which participants received £0.39 in compensation.)

After agreeing to be part of the study, the participants began by assessing two messages (selected randomly from the full pool and displayed one at a time) regarding perceived competence, using an adapted version of the perceived competence for exercising regularly scale [122]. The scale contained four items. The beginning of the items (e.g., "I feel...", "I am able...") was replaced by "This message makes me feel...". For example, "I feel confident in my ability to exercise regularly." was changed to "This message makes me feel confident in my ability to exercise regularly." Next, participants were asked three closed-ended questions related to individuals' characterizations: their gender, age, and exercise habits. Each participant assessed two messages, which created a total of 10 trials.

4.3.2.1 Results (Pilot Study: Classification of Text Messages)

As stated preciously, 150 individuals participated in this study. A total of 75% of the subjects were female (Table 4.6, page 80). Participants' ages ranged between 18 and 72 years old (mean≈37, SD≈13). The vast majority of the participants (79%) were in their 20s through 40s (Table 4.6, page 80).

The individuals in our sample showed a diversified pattern of exercise habits (Table 4.6, page 80). Overall, we can categorize all exercise patterns into four general major sub-groups: (a) do not exercise (I never exercise = 5%), (b) exercise irregularly (once in a while = 32%), (c) exercise regularly and moderately (once a week + twice a week = 31%), and (d) exercise regularly and intensively (three times a week + more than three times a week = 32%).

Each of the 30 text messages gathered from the Instagram page of the *Runkeeper* activity tracker service (Table 4.5) was assessed, on average, 10 times. The vast majority of Cronbach's alphas were higher than 0.9 (Table 4.5), which indicates, in general, a high level of internal consistency for our adapted scale. The lower Cronbach’s alpha obtained was 0.7. The text messages with an overall average assessment of competence score with a standard deviation

higher than 1.44 were excluded from the message selection process in stages 2 and 3 (strikethrough messages in (Table 4.5).

Table 4.5. The averages (M), standard deviations (SD), and Cronbach's alphas (α) for all assessed text messages following an adapted version of the scale of perceived competence for exercising regularly (with 0 indicating extremely "not at all true" and 6 indicating "very true"). The strikethrough text messages did not pass the requirements to be considered for selection for stages 2 or 3 (present an SD higher than 1.44).

M	**SD**	***α***	**Message (ID)**
4.25	.80	.83	Strength comes from the things you once thought you couldn't. (1)
4.20	1.00	.94	Strive for progress not perfection. (2)
4.15	1.08	.96	Start where you are. Use what you have. Do what you can. (3)
4.12	1.23	.97	We are what we repeatedly do. Excellence, then, is not an act, but a habit. (4)
4.10	1.55	.98	~~Good habits take time, patience, and hard work.~~ (5)
4.07	1.70	.98	~~You don't have to be the best, you just have to give it your best.~~ (6)
3.77	1.08	.79	All great achievements require time. (7)
3.75	1.19	.96	If it doesn't challenge you, it won't change you. (8)
3.63	1.68	.96	~~You have to believe in yourself.~~ (9)
3.50	1.96	.90	~~Being defeated is often a temporary condition. Giving up is what makes it permanent.~~ (10)
3.50	1.56	.92	~~A failure isn't a failure if it prepares you for success tomorrow.~~ (11)
3.50	1.67	.96	~~When you want to quit, remember your dreams.~~ (12)
3.47	1.56	.90	~~We are what we repeatedly do.~~ (13)
3.35	1.44	.95	The moments that challenge us the most define us. (14)
3.33	0.99	.71	Just keep on going. You are doing this for yourself and nobody else! (15)
3.32	1.23	.88	When you cross the finish line, no matter how slow or fast, it will change your life forever. (16)
3.27	1.07	.88	Be stronger than your excuses. (17)
3.25	1.48	.92	~~The way to get started is to quit talking and begin doing.~~ (18)
3.25	2.37	.98	~~Don't fear moving slowly forward…fear standing still.~~ (19)

3.17	1.74	.96	~~I don't know if I can, but I trust that I will.~~ (20)
3.12	1.59	.96	~~Life is for participating, not for spectating.~~ (21)
3.00	1.41	.93	Believe in your potential even if you haven't seen the results. (22)
3.00	1.24	.96	All progress takes place outside the comfort zone. (23)
2.90	1.62	.96	~~Don't stop when you're tired. Stop when you're done.~~ (24)
2.90	1.74	.95	~~We can always go a little further, push a little harder, and last a little longer.~~ (25)
2.82	1.27	.95	A goal is just an awesome way to force growth on yourself. (26)
2.75	1.87	.97	~~Faith is taking the first step, even when you don't see the whole staircase.~~ (27)
2.67	2.09	.97	~~Persistance can change failure into extraordinary.~~ (28)
2.42	1.40	.94	Do or do not. There is no try. (29)
2.15	1.03	.90	You must expect great things of yourself before you can do them. (30)

4.3.3 Main Study 1: Online Quasi-Experiment

The main goal of this study was to examine interaction effects between competence-focused text messages and aesthetic pleasure, namely: (1) to verify whether stronger aesthetic pleasure (from the visual presentation of perceived competence-focused messages) would create a difference in the perception of how motivating a text message is; (2) to verify whether there are interaction effects between (several levels of perceived) competence-focused text messages and (perceived levels of) aesthetic pleasure. This examination would be relevant to understanding the extent to which aesthetic pleasure can affect text content perception*;* (3) if we found that aesthetic pleasure had an impact on the perception of how motivating a message is, whether this immediate impact extended to intrinsic motivation.

We designed an online quasi-experiment with one independent variable and one marker variable. The independent variable was competence-focused text messages and had three levels: low, neutral, and high. The six text messages employed (two in each level) were selected from the assessment of text messages from stage 1 (Table 4.5, page 76). The marker variable was aesthetic pleasure (levels: ugly, impartial, beautiful). To increase the chances of producing a visual presentation that matched participants' visual preferences, we first assessed participants'

text design preferences (Figure 4.11). Only after that did we present a visual stimulus corresponding to their selected visual preferences.

The text design preferences were assessed following the order: text alignment (left or center), font family (serif, sans, slab, or script) [24], text caps (lowercase, uppercase), and color scheme (elegant, decorative, bold, or modern) (Adobe Spark's color palette [25]) (Figure 4.11). (Within each text design feature, the corresponding options were shown in random order).

After text design preferences were assessed, participants were randomly assigned to one condition and then to one message (out of a total of two) within that condition. The pool of messages in the condition of low competence-focused messages consisted of the text messages (IDs) (29) and (30) (the two messages with the lowest average) of Table 4.5, page 76. In this table, we can also see the pool of messages selected for the neutral (Messages IDs (22) and (23), both with a mean = 3.00) and high (message IDs (1) and (2), with a mean = 4.25 and 4.20 respectively) competence-focused message conditions. All options for text design preferences with the possibility of being randomly assigned to one of two messages in each text condition created a total of 768 manually created visual stimuli.

Through the platform Prolific, we recruited 500 individuals to participate in the study. Individuals were screened by nationality (UK) and by participation in previous studies (not participated). Each participant received a monetary reward of £0.39 (corresponding to £7.80 per hour; the time assigned to complete the survey was three minutes). The study began by having participants select their text design preferences. This was followed by the presentation of a personalized visual stimulus (constituting of a text message and a visual text presentation). Next, participants were asked to assess how motivating or demotivating the presented text message was, and to assess aesthetic pleasure in terms of the text aesthetics presented (scale [11]). Lastly, the participants' intrinsic motivation (scale BREQ-3 [173]) was measured and participants were asked to indicate their age, gender, and exercise habits.

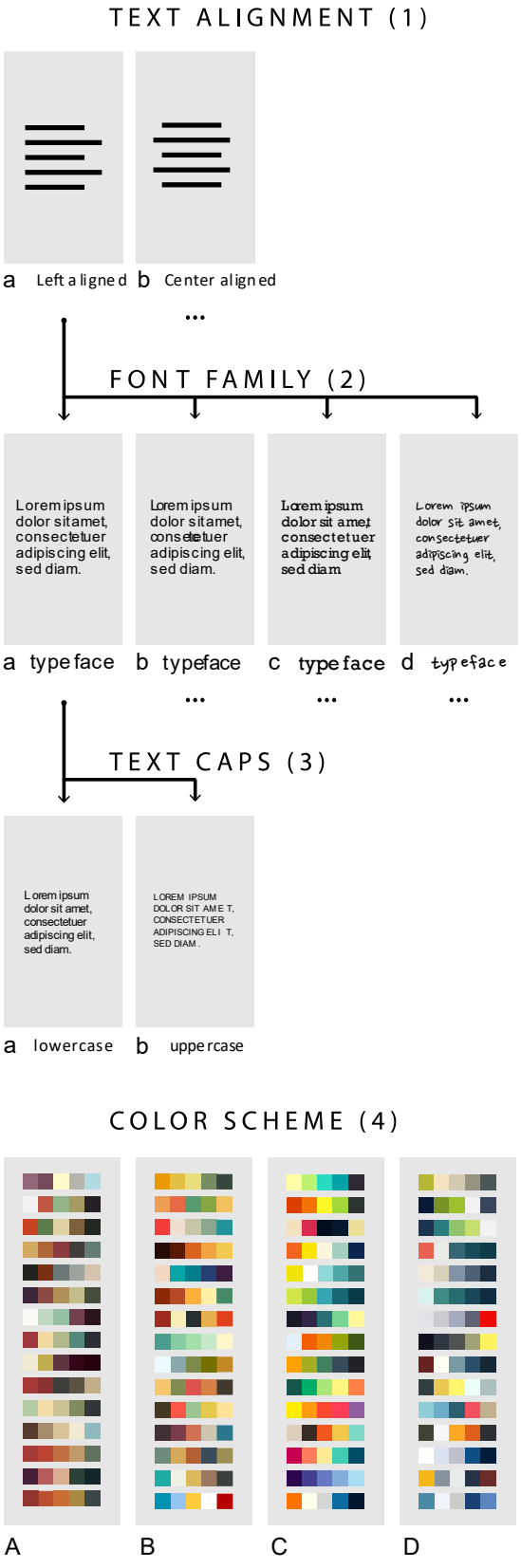


Figure 4.11. The scheme shows how text design preferences were assessed. First, users selected which text alignment they preferred (1). Next, considering their text alignment choice, they assessed their

preferred font family (2). For example, in the present scheme, the user would have selected left-aligned, which led to their viewing the text in the selection of the font family (2) left-aligned. In terms of text caps selection (3), the users also saw their previous choices reflected in terms of how the text was presented. In the scheme, for example, we can see in point (3) that the user had selected left-aligned text in (1) and serif typefaces in (2). Finally, in the color scheme selection (4), the previous choices had no influence. In other words, all users saw the same visual presentations.

4.3.4 Results (Main Study 1: Online Quasi-Experiment)

A total of 500 individuals were recruited to participate in the online quasi-experiment. Most participants were female (66%, Table 4.6, below). The mean age was ≈ 38 years old, with a standard deviation of ≈ 13 years old. Most participants' age ranged between 20 and 49 years old. Almost one-third of the participants reported engaging in exercise irregularly (once in a while = 29%), followed by 21% of participants who reported engaging in exercise regularly and very often (more than three times a week = 21%) (Table 4.6).

Table 4.6. Descriptive characteristics of the study groups in each stage, and percentage of participants in each study.

Characteristic	Percent in pilot study	Percent in main study 1	Percent in main study 2
Gender			
Female	75%	66%	81%
Male	25%	34%	19%
Age group			
18–19	2%	1%	0%
20–29	31%	34%	27%
30–39	28%	25%	40%
40–49	20%	21%	25%
50–59	11%	12%	6%
60–69	6%	5%	2%
>70	2%	2%	0%
Exercise Habits			
I never exercise	5%	8%	8%

Once in a while	32%	29%	23%
Once a week	12%	14%	6%
Twice a week	19%	13%	13%
Three times a week	19%	15%	23%
More than three times a week	13%	21%	27%
Number of Participants	150	500	48

Next, we show the percentage of participants in terms of their text design preferences. As we can see, in Table 4.7, it seems that, in general, there was no clear preference regarding text alignment. On the other hand, it appears that there was a preference for sans font-families, lowercase text-caps, and bright colors (bold color-scheme (c)) among the participants.

Table 4.7. Text design preferences among participants.

Text Alignment (1)			
Left Aligned (a)	*Centered (b)*		
56%	44%		
Font-Family (2)			
Serif (a)	*Sans (b)*	*Slab (c)*	*Handwriting (d)*
27%	48%	23%	2%
Text Caps (3)			
Lowercase (a)	*Uppercase (b)*		
88%	12%		
Color Scheme (4)			
Elegant (a)	*Decorative (b)*	*Bold (c)*	*Modern (d)*
12%	21%	55%	12%

Over half of the participants perceived the personalized visual presentation of the text message presented to them as positive (59%) (beautiful), 24% as unfavorable (ugly), and 17% as neutral (impartial) (Table 4.8, below).

Table 4.8. Number of participants per level of aesthetic pleasure and level of competence-focused messages.

Aesthetic Pleasure	**Competence-Focused Messages**			Total
	Low	*Neutral*	*High*	
Ugly	42	43	36	121
Impartial	36	30	21	87
Beautiful	87	93	112	292
Total	165	166	169	500

4.3.4.1 How aesthetic pleasure influences how motivating a competence-focused text message is perceived as being

Determining the effect that competence-focused messages have on how motivating a text message is perceived as being (an ordinal variable) depends on the level of the aesthetic pleasure. Thus, we ran a nonparametric equivalent to the factorial ANOVA. To do this, we applied an aligned-rank-transform analysis to the data following the process described by Wobbrock and colleagues (CHI'11) [174].

There was a statistically significant interaction between competence-focused messages and aesthetic pleasure in terms of how motivating a text message is perceived as being, $F(4, 491) = 3.508$, $p = .008$, partial $\eta 2 = .028$. Subsequently, we conducted a cross-factor pairwise comparison running a Kruskal-Wallis H test followed by pairwise comparison results using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented.

As illustrated in Figure 4.12, this post hoc analysis revealed statistically significant differences in scores within low-competence messages between the beautiful (mean rank = 246.81) and ugly (mean rank = 129.68) ($p = .001$) aesthetic pleasure levels, as well as in scores within neutral-competence messages between the beautiful (mean rank = 321.06) and ugly (mean rank = 205.71) ($p = .001$) perceived aesthetic levels.

Nevertheless, there was no significant differences between the ugly (mean rank = 247.90) and impartial (mean rank = 240.76) (p = 1.00) aesthetic levels in high-competence messages. As well as, no significant differences between the ugly and beautiful (mean rank = 287.50) (p = 1.00) aesthetic levels in high-competence messages, and between the impartial and beautiful aesthetic levels in high competence messages (p = 1.00).

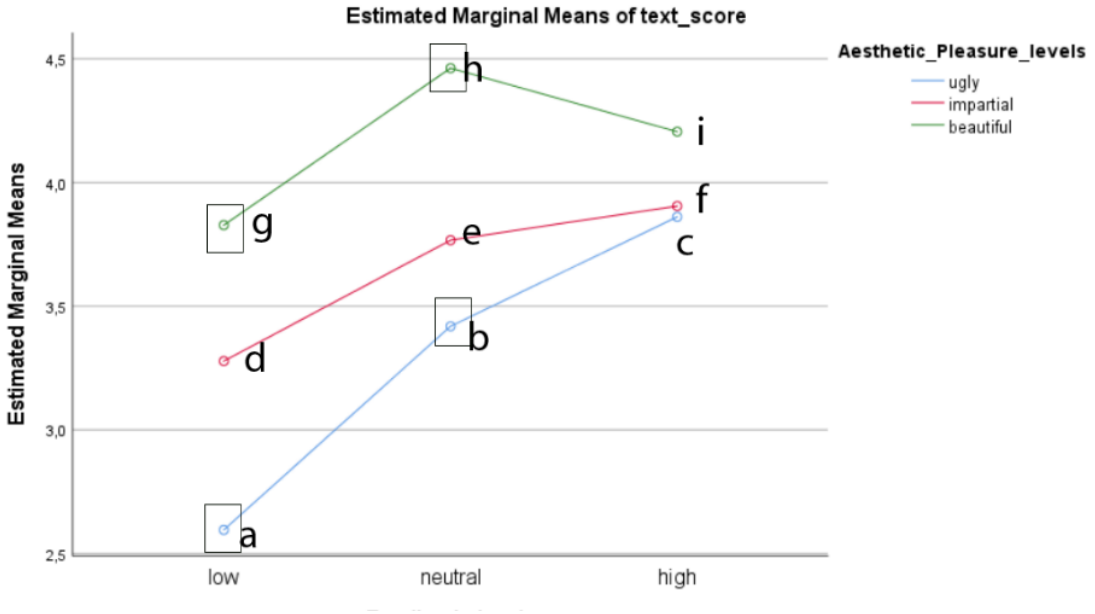


Figure 4.12. The effects of aesthetic pleasure at each level of text-competence messages. The squares indicate significant differences between each other within each level of competence-focused messages. For example, within the low level of messages, the differences between ugly and beautiful levels were statistically significant.

4.3.4.2 How aesthetic pleasure influences the power of a competence-focused text message on intrinsic motivation

Next, we determined whether the immediate effect that competence-focused messages have on intrinsic motivation (continuous variable) depends on the levels of aesthetic pleasure. The data were not normally distributed, as assessed by Shapiro-Wilk's test (p<.05). Therefore, we ran a nonparametric equivalent to the factorial ANOVA (following the procedures by Wobbrock et al. [174]).

The interaction effect between levels of competence-focused messages and levels of aesthetic pleasure was not statistically significant, F(4,491) = 0.943, p = .439, partial η2 = .008. The main effect of levels of competence-focused messages was not statistically significant (F(2,491) =

0.102, p = .903, partial η2 = .000), nor was the main effect of aesthetic pleasure (F(2,491) = 2.527, p = .081, partial η2 = .010).

4.3.5 Main Study 2: Longitudinal Quasi-Experiment

As the main study two, we designed a short-term longitudinal quasi-experiment of four weeks to investigate how aesthetic pleasure influences exercise motivation and exercise behavior over time. Seventy-five subjects were recruited from the Prolific platform. Participants were screened (using Prolific filters) for nationality (UK) and participation in one of our previous studies (no participation), as well as for whether they currently owned an activity tracker excluding smartwatches (e.g., Fitbit, Xiaomi Mi Band, Microsoft Band) (currently own an activity tracker).

The experiment had three conditions (text-only, aesthetics, and control) and 25 participants were randomly assigned to each. The differences between each condition were in the visual presentation of the text messages. In the text-only condition, the text messages were displayed as body-text. In the aesthetics condition, the text messages were displayed embedded in a visual presentation. Lastly, in the control condition, there was no manipulation of the text presentation, and no text messages were presented.

On the first day of the study, we published, in Prolific, a call to participate in only our first survey. We collected participants' Prolific IDs so that we could later invite the same individuals to participate in the next inquiries (assessments). Each week, there were two time points of intervention. On Mondays and Thursdays, we set up a study on Prolific, asking for participation in a survey. Each survey (assessment) was active (accepting answers) until the last night (8 p.m. Greenwich time) before the day when the next assessment would be launched (e.g., a Monday call was active until 8 p.m. the following Wednesday). The individuals who did not participate in the call stopped receiving calls to participate in the next calls (were dropped out). We ran the study between January 6th and February 2nd of 2020.

The first and last assessments investigated different types of exercise motivation (extrinsic, intrinsic, and lack of motivation) through the BREQ-3 scale [81, 173] under each study condition. The first assessment served to create baseline measurements to later be compared to the measurements of the last evaluation. Intrinsic motivation alone was also assessed in the second assessment of the second week, to examine differences in intrinsic motivation (that text messages may influence) in a middle-time point of intervention. All these measurements allowed us to follow the evolution of the subjects' intrinsic motivation in all conditions over the intervention time.

In the other assessments of the intervention, subjects in the text-only and aesthetics conditions were exposed to a visual stimulus. The visual stimulus presented each time to each participant was randomly chosen from a pool of stimuli, considering the condition the participant was in and the visual stimuli already delivered to him/her. Each condition, contained a pool with a total of six visual stimuli. After we provided all stimuli to participants from their corresponding pool, we started the same process of visual stimuli selection using the same full pool. That is, during the last week of the intervention, when it was time to deliver the seventh and eight stimuli to the subjects, we delivered two visual stimuli that the participants had already received (repeated).

The visual presentations of the visual stimuli that were created for subjects in the aesthetics condition followed the design text aesthetic preferences of the majority of the study participants in the main study 1 (Table 4.7, page 81) (no preference regarding text alignment, fonts-sans, text caps-lowercase, color scheme-bold). Characterization questions (exercise habits, age, and gender) were posed to participants throughout several assessments (not all at once).

4.3.6 Results (Study 2: Longitudinal Quasi-Experiment)

We recruited 75 participants distributed equally among study's three conditions. Over the four weeks, 27 participants dropped from the study. We finished the study with 15 participants in the aesthetics condition, 16 participants in the text-only condition, and 17 participants in the control condition (48 participants in total).

The majority of participants were female (81%). The mean age was 36 years old, with a standard deviation of ≈ 10 years. Participants' ages ranged mainly between 20 and 49 years old (Table 4.6, column three). The percentage of participants who did not have regular exercise habits (31%) was lower than that in studies 1 and 2 (37% in both).

Table 4.9 shows participants' characterization in study 3 by condition. In all three conditions, the majority of participants were female. Participants' ages varied mostly between 20 and 49 years old in the three conditions. However, in the control condition, the larger group was between 40 and 49 years old (41%), while the larger groups in the text-only and aesthetics conditions were between 30 and 39 years old (44% and 40%, respectively).

In general, we can observe, in Table 4.9, that the aesthetic condition tended to have more individuals who do not exercise regularly (never exercise + once in a while = 46%) than the control (30%) and text-only (19%) conditions. Nonetheless, in all conditions, although varying in frequency, most of the participants reported exercising regularly.

4.3.6.1 Text Message Scores in the First Assessment

In our previous experiment, aesthetic pleasure did not influence the perception of how motivating a high-competence focused text message is. In this new experiment, we used only positive competence-focused text messages. We started by verifying whether this latest experiment repeated the results of our previous experiment.

Table 4.9. Percentage of participants in each condition of study 3 following several descriptive characteristics

Characteristic	**Conditions**		
	Control	***Text-only***	***Aesthetics***
Gender			
Female	82%	69%	93%
Male	18%	31%	7%
Age Group			
20-29	18%	31%	33%
30-39	35%	44%	40%
40-49	41%	13%	20%
50-59	6%	6%	7%
60-69	0%	6%	0%
Exercise Habits			
I never exercise	6%	6%	13%
Once in a while	24%	13%	33%
Once a week	6%	13%	0%
Twice a week	18%	12%	7%
Three times a week	23%	25%	20%
More than three times a week	23%	31%	27%

.

To do this, we categorized the aesthetics mean scores of the first assessment of the experiment in negative and positive aesthetics. (The only score value considered neutral was added to positive aesthetics.)

A Kruskal-Wallis H test was run to determine whether there were differences among the three groups—text-only presentation, negative aesthetics, and positive aesthetics—in terms of the scores regarding how motivating a text message is.

Distributions of the dependent variable scores were not similar for all groups, as assessed by visual inspection of a boxplot (Figure 4.13, page 87). The mean rank scores were not statistically significantly different between groups, $\chi 2(2) = 4.457$, $p = .108$.

4.3.6.2 Baseline Motivation Comparison Among Groups

Before analyzing intrinsic motivation levels over the four weeks of the experiment, we compared the baseline of the levels of controlled extrinsic motivation, autonomous extrinsic motivation, and intrinsic motivation between groups to understand whether they were similar in terms of exercise motivation profile.

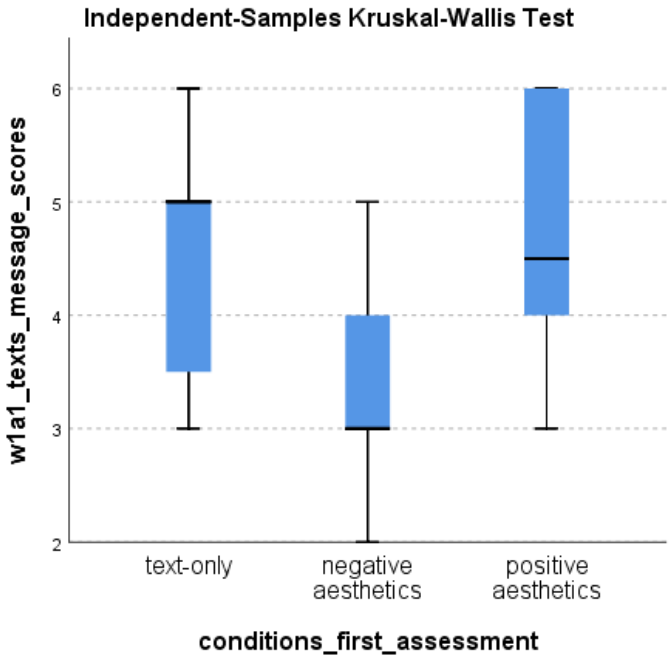


Figure 4.13. Distribution of text message scores by condition in the first assessment.

The classification of aesthetic pleasure groups was done as per the following method. The assessments of aesthetic pleasure over time of each participant were divided following the mean of the aesthetic pleasure over time (of the eight assessments, two in each week) and their standard deviation.

Negative means with a standard deviation of less than 1.4 were classified as negative aesthetics. Correspondingly, positive means with a standard deviation of less than 1.4 were

classified as positive aesthetics. Means with a standard deviation of higher than 1.4 were classified as unstable perceived aesthetics.

This produced a total of five individuals in the unstable aesthetic pleasure over time group, six individuals in the positive aesthetics group, and four individuals in the negative aesthetics group.

Kruskal-Wallis H tests were run to determine whether there were differences in the types of behavior regulation scores between the five groups: the control (n = 17), text-only (n = 16), negative aesthetics (n = 4), positive aesthetics (n = 6), and unstable aesthetics (n = 5).

There were no outliers in all types of behavior regulations (amotivation, external, introjected, identified, integrated, and intrinsic) as assessed by boxplots.

The distribution of all types of behavior regulation was the same across categories of the groups variable ($p > .05$).

Overall, participants presented low levels of amotivation (median of all groups = 1.25), low levels to neutral controlled extrinsic motivation (low levels of external regulation [Mdn = 1.63] and neutral levels of introjected regulation [Mdn = 3.25]).

Moreover, there were slightly positive levels of autonomous extrinsic motivation (low positive levels of identified regulations [Mdn = 3.63] and neutral levels of integrated regulation [Mdn = 2.63]) and neutral levels of intrinsic behavior regulation (Mdn = 3.00).

4.3.6.3 Comparison of Intrinsic Motivation Over Time

Figure 4.14 shows the values for intrinsic motivation over time by group. We started by aiming to run a two-way mixed ANOVA to understand whether intrinsic motivation changes over time following the perception of aesthetic pleasure.

However, data were not normally distributed in all conditions, as assessed by Shapiro-Wilk's test ($p < .005$). Consequently, we did not run the aimed test, and it was not possible to examine whether there is an interaction between text presentations and time on intrinsic motivation.

Kruskal-Wallis H tests were run to examine whether there were differences in the distributions of intrinsic motivation between groups at each time point, while a Related-Samples Friedman's Two-Way Analysis of Variance by Ranks test was conducted to examine whether there were differences in the distributions of intrinsic motivation over time.

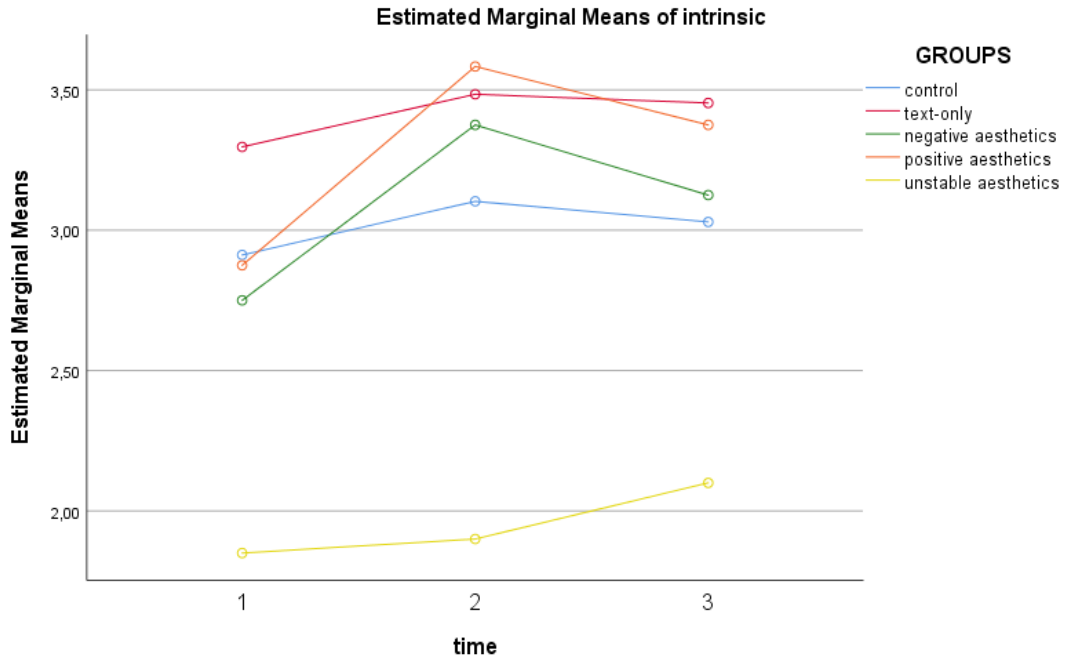


Figure 4.14. Intrinsic motivation over time by group.

Intrinsic Motivation Difference Between Groups in the First Assessment

A Kruskal-Wallis H test was conducted to determine whether there were differences in intrinsic motivation scores in the first assessment between groups. Distributions of intrinsic motivation scores were similar for all groups.

Median intrinsic motivation scores increased from unstable aesthetics (1.75), to negative aesthetics (2.63), to control (3.00), to positive aesthetics (3.12), to text-only (3.25), but the differences were not statistically significant, $\chi 2(4) = 5.851$, $p = .211$.

Intrinsic Motivation Differences Between Groups in the Second Week

A Kruskal-Wallis H test was conducted to determine if there were differences in intrinsic motivation scores in the second time-point (week 2, assessment 2) between groups.

Distributions of intrinsic motivation scores were not similar for all groups. The mean rank of intrinsic motivation scores was not statistically significantly different between groups, $\chi 2(4) = 6.612$, $p = .158$.

Intrinsic Motivation Differences Between Groups in the Fourth Week

A Kruskal-Wallis H test was conducted to determine if there were differences in intrinsic motivation scores in the third time-point (week 4, assessment 2) between groups. Distributions of intrinsic motivation scores were similar for all groups.

Median intrinsic motivation scores increased from unstable aesthetics (1.75) to control (3.25), to text-only (3.38), to negative aesthetics (3.50), to positive aesthetics (3.63), but the differences were not statistically significant, $\chi 2(4) = 5.190$, $p = .268$.

Intrinsic Motivation Differences Over Time

A Friedman test was run to determine whether there were differences in intrinsic motivation over four weeks. Pairwise comparisons were performed (SPSS Statistics, 26) with a Bonferroni correction for multiple comparisons.

Intrinsic motivation was statistically significantly different at the different time points during the four week intervention, $\chi 2(2) = 12.863$, $p < .002$.

Post hoc analysis revealed statistically significant differences in intrinsic motivation levels from the first assessment (*Mdn* = 3.00) to mid-time-point (week 2) (*Mdn* = 3.38) and the first assessment to third-time-point (week 4) (*Mdn* = 3.25) but not the mid-time-point to third-time-point.

4.3.7 Pilot Study—Number of Steps Over Time

We received the physical activity tracked data from 15 participants, five in each condition. In the aesthetics condition, three participants presented a negative average of aesthetic pleasure over time, while two participants showed a constant positive average of aesthetic pleasure over time. The overall average of aesthetic pleasure (in the aesthetics condition) between participants was 3.32 (neutral).

We note that due to the sample size (five individuals in each condition), the results presented in this pilot study should not be generalized to the population. This pilot study intends only to provide a preliminary suggestion of the effect of aesthetic pleasure on exercise behavior.

Because none of the numbers of steps was near zero over time, we decided to analyze the dependent variable (number of steps) as continuous. A Kruskal-Wallis H test was conducted to determine whether the baseline of the number of steps differed based on the condition. Distributions of the numbers of steps were similar for all conditions, as assessed by visual inspection of a boxplot. The scores for the median number of steps were not statistically significantly different between conditions (control = 7657, text-only = 9733, aesthetics = 4737), $\chi 2(2) = 1.620$, $p = .445$.

To determine whether the number of steps changed over time, depending on the text-presentation condition (none, text-only, and neutral aesthetic pleasure), we conducted a two-way

mixed ANOVA. The between-subjects factor was the type of text presentation, while the within-subjects factor was the time (number of steps in week 1, week 2, and week 3).

There were no outliers in the data, as assessed by inspection of a boxplot. The dependent variable (number of steps) was normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices ($p = .391$). Mauchly's test of sphericity indicated that the assumption of sphericity was met for the two-way interaction, $\chi2(2) = 1.47$, $p = .479$.

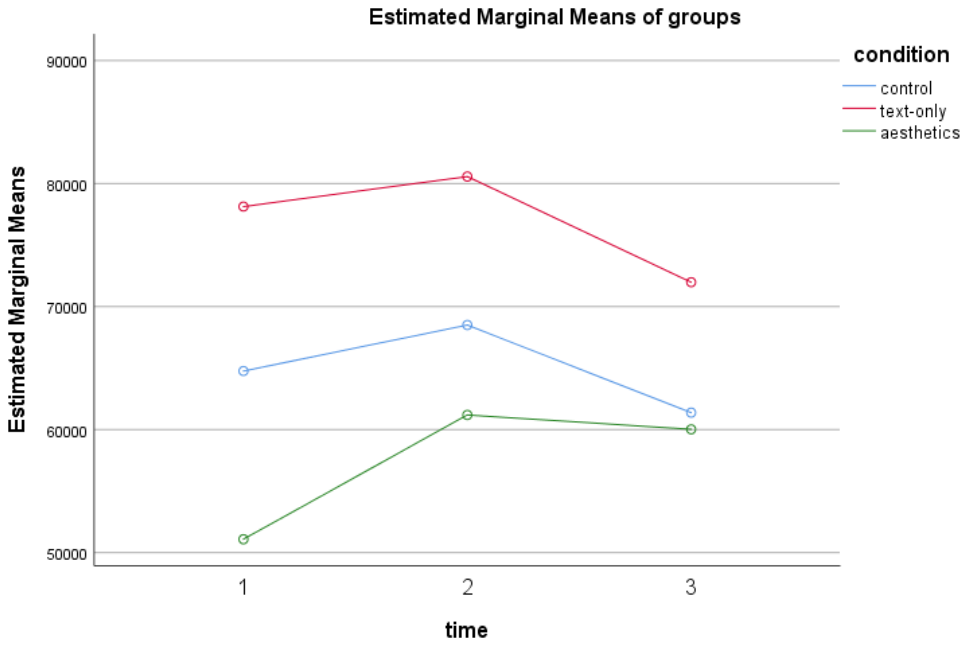


Figure 4.15. Line graph showing the number of steps per week in each condition.

There was no statistically significant interaction between the intervention (type of text presentation) and time on the number of steps per week (Figure 4.15), $F(4,24) = 1.09$, $p = .383$, partial $\eta2 = .154$.

The main effect of time showed no statistically significant interaction in the mean number of steps at different time points, $F(2,24) = 2.070$, $p = .148$, partial $\eta2 = .147$. The main effect of conditions showed no statistically significant interaction in the mean number of steps at different time points, $F(2,12) = .49$, $p = .620$, partial $\eta2 = .077$.

4.3.8 Discussion

Our first experiment revealed that aesthetic pleasure could have an immediate positive impact on how motivating a text message is perceived as being. However, its influence seems to be limited by the quality of text messages. Low-quality text messages—in this context, low and neutral competence-focused text messages—can be enhanced by perceived beautiful visual presentations. Still, positive competence-focused text messages were not enhanced by perceived beauty (aesthetic pleasure). Regarding the immediate influence of aesthetic pleasure on intrinsic motivation, there was no direct influence of aesthetic pleasure on intrinsic motivation.

Our short-longitudinal study verified the effect of aesthetic pleasure on text message scores. Data from the first assessment of this study showed that aesthetic pleasure did not influence how motivating positive competence-focused text messages were perceived as being.

Regarding the effect of time and aesthetic pleasure over four weeks, the data analysis revealed that exercise motivation profiles were similar across all groups. The interaction effect between time and aesthetic pleasure could not be examined due to the particular characteristics of the data. Aesthetic pleasure over time— negative, positive, or unstable (inconstant)—did not show an effect on intrinsic motivation levels. Time influence analysis over time revealed—from the first assessment to the second time point (to the end of the second week) —an influence on intrinsic motivation, that was maintained in the third time-point (closed to the end of the fourth week). We note that perhaps participants started to feel somehow controlled over the weeks, and that this, in turn, might have undermined the effect of text messages and aesthetic pleasure. It also might happen that the effect of text messages and aesthetic pleasure was not captured due to the small sample size.

The number of steps also did not change significantly over time between the conditions text-only, control, and aesthetics. However, we highlight significant limitations in this pilot study. The small sample size does not allow us to generalize the findings. There are two profiles of aesthetic pleasure over time among (the small number of) participants in the aesthetics group (negative and positive between five participants). A future study is necessary—one with a more significant overall sample size and a differentiation between aesthetic pleasure over time (i.e., positive, negative, inconstant).

The positive influence of text messages (presented as text-only) found by other studies [26, 91, 125] on exercise motivation and behavior was not present in our investigation. A systematic review [15] notes that, often, the development of text messages used in the studies lacks specificity, which can explain differences between our results and those of other studies. Furthermore, prior studies [26] that found significant changes in physical activity due to the text

messaging intervention lacked a control group, which may have confounded the significant changes in physical activity. In fact, in our study, time presented a significant positive effect on intrinsic motivation.

4.3.8.1 Other Limitations

In general, a bias from using online crowdsourcing platforms might exist, for example, in terms of the participants' naivety. However, when compared to the (apparently) most popular platform. Amazon Mechanical Turk, studies have shown that the Prolific platform shows better data quality [121]. Participants also tend to be more naive and more engaged in the studies [121].

We also note that in the Prolific platform, there is an ethical concern, for example, regarding rewards. Survey publishers must adhere to the requirement to provide a minimum reward of £5 per hour. In study 1, study 2, and study 3, there is a potential gender bias. The results might not reflect the attitudes of males.

4.3.9 Conclusion

Aesthetic pleasure can enhance our perception of low-quality text messages. However, it does not seem to influence the motivational power of competence-focused text messages on regarding intrinsic motivation. This means that design aesthetics can be used to enhance perceived low-quality text messages.

Moreover, while design aesthetics would not influence individuals' perceptions of positive competence-focused text messages, it also would not harm those perceptions. Therefore, activity tracker services or digital apps that present text messages to individuals can use (personalized) aesthetics to influence the impression of lower-quality text messages.

Summing up, a quasi-experiment with 500 participants revealed that aesthetic pleasure has a small immediate effect on how motivating low- and neutral-competence-focused text messages are perceived to be. Still, it has no impact on the perception of the motivation of high-competence-focused messages. Regarding the small effect found, aesthetic pleasure changed participants' perception of the level of motivation of low- and neutral-competence-focused messages. Still, it was not able to influence participants' intrinsic motivation for exercise (enjoyment from doing exercise). That is, it did not increase the (lack) of motivating power of low- and neutral-competence focused messages.

A second study with 48 participants over four weeks, in which only high-competence-focused messages were employed, showed that the influence of the messages was similar to intrinsic

motivation and independent of the variation of aesthetic pleasure over time. Overall, aesthetic pleasure from visual quotes did not enhance the motivating potential of text messages.

5

General Discussion and Conclusions

We started by uncovering why people view motivational text messages (*Study 1: How do Motivational Text Messages Promote Exercise Motivation: An Exploratory Study*). Individuals who exercise regularly reported viewing them to strengthen their exercise motivation and remind them of their exercise goals and the benefits of exercising. Individuals who regularly seek motivational text messages but who did not yet have exercise habits presented one main motive to looking for motivational text messages: boosting their exercise motivation. The two groups—which had the commonality of seeking motivational text messages but which differed in exercise habits—presented significant differences in motivation for exercising. As described in the literature, we found that the individuals who reported exercising regularly showed significantly higher self-determined motivation types to exercise. These results suggest that the motives for exercising might mediate the effectiveness of motivational text messages.

These results make us suspect that motivational text messages might support exercise motivation to those who already present mainly self-determined motivation to exercise. However, they are not necessarily able to trigger a behavior change in those who have less self-determined motivation. Guided by this suspicion, we believed it could be worth examining the effect of aesthetic pleasure not only on intrinsic motivation (linked to long-term exercise) but also on extrinsic identified behavior regulation, linked to the early start of regular exercise [150].

Regarding the visual presentation of motivational text messages, both groups presented the same results. Participants reported that an aesthetically appealing visual presentation helps to instill a positive feeling regarding the textual content. Moreover, most participants consider the visual presentation is as important as the textual content for them. Next, we designed a set of

experiments to explore how aesthetic pleasure impacts motivational text messages' power. The results of these experiments are summarized below. Next, we answer the study research questions.

Study 2: Messages with no classification

- Aesthetic pleasure did not strengthen the motivating capability of perceived **motivating** and **neutral** text messages on (short-term) exercise motivation.

Study 3: Positive framed messages

- Independent of perceiving a visual presentation as **beautiful** or **ugly**, the visual aesthetics **did not impact** subjects' assessment of positive-framed text messages' motivating capacities.
- Perceiving a visual presentation as **beautiful** or **ugly** also **did not** change the motivating capability **of positive-framed text message**s presented as text-only in the extrinsic identified behavior regulation.

Study 4: Self-liberating messages

- No influence was found of aesthetic pleasure levels on the motivating capability of the messages. Messages **were not perceived** as more motivating when the visual presentation was assessed as **positive** regarding aesthetic pleasure, or less motivating when the visual presentation was assessed as **negative**.
- The same results were found when the individuals were exposed to visual stimuli over several days.

Study 5: Competence-focused messages

- Aesthetic pleasure enhanced the perception of **low and neutral competence-focused** text messages.
- Still, it was not able to influence intrinsic motivation for exercising (enjoyment). In other words, it **did not increase** the (lack) of motivating power of low- and neutral competence-focused messages.

- Aesthetic pleasure **did not influence the motivational power of competence-focused text messages** on exercise enjoyment.
- Negative aesthetic pleasure **did not harm the perception** of positive competence-focused text messages.
- The aesthetic pleasure from visual quotes did not enhance text messages' motivating power over time (four weeks).

Keeping our studies' main conclusions in mind, we will next recap research questions and answer them jointly, then finish with a main conclusion for each of them.

RQ1: How does aesthetic pleasure impact the motivational capability of encouraging text messages?

RQ1.1. Does positive aesthetic pleasure make the text messages more motivating?

RQ1.2. Does negative aesthetic pleasure make the text messages less motivating?

RQ1.3. Does the frame of the text messages influence the power of their aesthetic pleasure?

RQ2: Subsequently, how does a text message's perceived motivational capability influence exercise motivation and enjoyment?

Our second study (*3.2 Study 2: Aesthetic Pleasure and Short-term Exercise Motivation*) revealed that differences in aesthetic pleasure—beautiful, neutral, ugly— in visual quotes did not affect the motivating capacity of perceived motivating and neutral text messages in exercise motivation (extrinsic identified behavior regulation).

In our third study, we did not use text messages found on social media pages of commercial activity trackers as in the first experiment. Instead, we explored positive-framed messages. The results were similar. Aesthetic pleasure did not affect text messages in extrinsic identified behavior regulation.

Moreover, the assessment of positive-framed text messages has not changed according to aesthetic pleasure from the visual presentation.

In our fourth study (*Study 4: Self-Liberating Text Messages*), the participants received messages classified as self-liberating, over five days. Although individuals were exposed to visual stimuli over a more extended period than in the two other previous experiments, similar results were found. Aesthetic pleasure did not show an effect on the motivating capability of the messages in extrinsic identified behavior regulation (short-term exercise motivation).

Our fifth and last study (*Study 5: Competence-focused Messages and the Number of Steps over Three Weeks*), which classified messages by competence and exposed participants to visual stimuli over four weeks, revealed that aesthetic pleasure could have an immediate positive impact on how motivating a text message is perceived as being.

However, its influence seems to be limited by the quality of text messages. Low-quality text messages—in this context, low and neutral competence-focused text messages—can be enhanced by perceived beautiful visual presentations. Still, positive competence-focused text messages were not enhanced by perceived beauty (aesthetic pleasure).

Aesthetic pleasure also did not show an effect on exercise enjoyment, and the number of steps did not change significantly over the four weeks between the text-only, control, and aesthetics conditions.

Ultimately, the evidence found in our studies shows that positive or negative aesthetic pleasure does not necessarily change our perception of how motivating a text message is. While aesthetic pleasure tended to not enhance our perception of how motivating a message is, negative aesthetic pleasure did not negatively affect it.

Comparing the results of our last study to those of the others, we suspect that the own text content structure might mediate the impact of aesthetic pleasure. However, more studies are needed to reach a more precise conclusion.

Lastly, while in the last study aesthetic pleasure had a small effect on the perception of how motivating a message is, similar to the other studies, aesthetic pleasure did not increase the perception of enjoyment from exercise. In all related studies, aesthetic pleasure also did not influence short-term exercise motivation.

5.1 Future Work

This research project, considered an early project exploring the influence of aesthetic pleasure on visual quotes, left many future research possibilities. Some of them were the following.

Considering the experiments we conducted, the textual content characteristics might influence whether aesthetic pleasure can influence the textual content motivating capacity. We believe it would be interesting to investigate text messages' classification following the basic needs of self-determination theory—specifically, competence and autonomy. As we have pointed out in the literature review chapter, literature shows that there is still a lack of deep understanding of how the textual content structure impacts a text message's efficacy.

Taking our results into account, self-determination theory—in particular, its cognitive evaluation sub-theory—seems to be an appealing framework with which to work.

The context in which messages are applied can also be an important variable to the results we found. It might happen that in our online experiments, the individuals perceived the conditions as being artificial or they somehow felt controlled, as they were being paid to participate in the study. We suggest exploring the impact of aesthetic pleasure in scenarios perceived as being more natural to the activity.

Our initial exploratory survey also revealed that motivational text messages seem to work to support exercise motivation, but do not necessarily trigger a behavior change. It might be enlightening to deeply explore how the needs of both groups (exercisers and non-exercisers who seek motivational text messages) differ and how they impact the effectiveness of motivational text messages on exercise motivation—in other words, to understand why people who seek motivational text messages but who do not exercise regularly do not change exercise habits. What needs are not being fulfilled among this profile of individuals? Can motivational text messages help to suppress them?

5.2 Final Remarks

Our research project provides some clues regarding the influence of aesthetic pleasure from visual quotes. In general, the perception of aesthetic pleasure did not enhance the motivating capability of encouraging text messages. On the other hand, perceived ugly presentations did not diminish the perception of how motivating a motivational text message is.

The textual content was classified following several frameworks. When messages were classified following the cognitive evaluation theory, those messages were classified by perceived competence, and an effect was found on low and neutral competence-focused text messages; They were assessed as being more motivating. On the other hand, there was no effect on exercise motivation.

Our results show that if a positive effect of aesthetic pleasure from visual quotes exists, this effect can be quite dependent on the textual content's characteristics. On the other hand, our research studies were carried out in lab conditions, which might have hidden positive effects that aesthetic pleasure has in real-life contexts.

In conclusion, we found that aesthetically appealing visual presentations help to instill a positive feeling regarding the textual content. Moreover, in some circumstances, aesthetic pleasure can influence people's perception of an encouraging text message. However, whether and how aesthetic pleasure influences textual content's motivating capability requires further research.

Bibliography

[1] (ISO), I.O. for S. 1998. *ISO 9241: ergonomic requirements for office work with visual display terminals, VDTS - Part 11: guidance on usability.* Geneva: International Organization for Standardization.

[2] Adobe's New App, Adobe Post, Lets Anyone Create Professional Graphics: 2015. *https://techcrunch.com/2015/12/17/adobes-new-app-adobe-post-lets-anyone-create-professional-graphics/*. Accessed: 2020-02-17.

[3] Aesthetic: 2017. *https://en.oxforddictionaries.com/definition/aesthetic*. Accessed: 2017-06-29.

[4] Amazon Mechanical Turk page: 2019. *https://www.mturk.com/*.

[5] Arnheim, R. 1974. *Art and visual perception : a psychology of the creative eye*. University of California Press.

[6] Association, I.S. and C. and Research, C. for E. and B. 2015. The economic cost of physical inactivity in Europe. (2015).

[7] Bargas-avila, J.A. and Hornbæk, K. 2011. Old Wine in New Bottles or Novel Challenges ? A Critical Analysis of Empirical Studies of User Experience. *CHI '11 May 7-12, 2012, Vancouver, BC, Canada*. (2011), 2689–2698. DOI:https://doi.org/10.1145/1978942.1979336.

[8] Ben-Bassat, T. et al. 2006. Economic and subjective measures of the perceived value of aesthetics and usability. *ACM Transactions on Computer-Human Interaction*. 13, 2 (2006), 210–234. DOI:https://doi.org/10.1145/1165734.1165737.

[9] Berger, J. and Iyengar, R. 2013. Communication Channels and Word of Mouth: How the Medium Shapes the Message. *Journal of Consumer Research*. 40, 3 (2013), 567–579. DOI:https://doi.org/10.1086/671345.

[10] Birkhoff, D. 1933. Aesthetic Measure.

[11] Blijlevens, J. et al. 2017. The Aesthetic Pleasure in Design Scale: The development of a scale to measure aesthetic pleasure for designed artifacts. *Psychology of Aesthetics, Creativity, and the Arts*. 11, 1 (2017), 86–98. DOI:https://doi.org/10.1037/aca0000098.

[12] Bloch, P.H. 1995. Seeking the Ideal Form: Product Design and Consumer Response. *Journal of Marketing*. 59, 3 (1995), 16. DOI:https://doi.org/10.2307/1252116.

[13] Body Text: *https://practicaltypography.com/body-text.html*. Accessed: 2020-02-17.

[14] Borrelli, B. and Ritterband, L.M. 2015. Special issue on eHealth and mHealth: Challenges and future directions for assessment, treatment, and dissemination. *Health*

Psychology. 34, Suppl (2015), 1205–1208. DOI:https://doi.org/10.1037/hea0000323.

[15] Buchholz, S.W. et al. 2013. Physical activity text messaging interventions in adults: A systematic review. *Worldviews on Evidence-Based Nursing*. 10, 3 (2013), 163–173. DOI:https://doi.org/10.1111/wvn.12002.

[16] Burnham, D. Immanuel Kant: Aesthetics. *Internet Encyclopedia of Philosophy - A Peer-Reviewed Academic Resource*.

[17] Carcone, A.I. et al. 2013. Provider communication behaviors that predict motivation to change in black adolescents with obesity. *Journal of Developmental and Behavioral Pediatrics*. (2013). DOI:https://doi.org/10.1097/DBP.0b013e3182a67daf.

[18] Carney, R. and Firth, J. 2018. *mHealth and Physical Activity Interventions Among People With Mental Illness*. Elsevier Inc.

[19] Carpentier, J. and Mageau, G.A. 2013. When change-oriented feedback enhances motivation, well-being and performance: A look at autonomy-supportive feedback in sport. *Psychology of Sport and Exercise*. (2013). DOI:https://doi.org/10.1016/j.psychsport.2013.01.003.

[20] Carrotte, E.R. et al. 2017. "fitspiration" on social media: A content analysis of gendered images. *Journal of Medical Internet Research*. (2017). DOI:https://doi.org/10.2196/jmir.6368.

[21] Cavallo, D.N. et al. 2012. A social media-based physical activity intervention: A randomized controlled trial. *American Journal of Preventive Medicine*. 43, 5 (2012), 527–532. DOI:https://doi.org/10.1016/j.amepre.2012.07.019.

[22] Chan, J.S.Y. et al. 2019. Special Issue – Therapeutic Benefits of Physical Activity for Mood: A Systematic Review on the Effects of Exercise Intensity, Duration, and Modality. *The Journal of Psychology*. 153, 1 (2019), 102–125. DOI:https://doi.org/10.1080/00223980.2018.1470487.

[23] Cocozza, P. 2014. Read this and feel better – how inspirational guff invaded our lives. *The Guardian*.

[24] Coles, S. 2013. *The Geometry of Type: The Anatomy of 100 Essential Typefaces*. Thames and Hudson Ltd.

[25] Color Palette for Images: *https://spark.adobe.com/make/color-palette/*. Accessed: 2020-02-17.

[26] Connelly, K. and Mutsuddi, A.U. 2012. Text Messages for Encouraging Physical Activity. *PervasiveHealth*. (2012), 33–40. DOI:https://doi.org/10.4108/icst.pervasivehealth.2012.248715.

[27] Consolvo, S. 2012. Designing for Healthy Lifestyles: Design Considerations for Mobile Technologies to Encourage Consumer Health and Wellness. *Foundations and Trends® in Human–Computer Interaction*. 6, 3–4 (2012), 167–315. DOI:https://doi.org/10.1561/1100000040.

[28] Dahlström, A. and Safari, an O.M.C. 2019. Storytelling in Design.

[29] Damasio, A.R. 2005. *Descartes' error : emotion, reason, and the human brain*.

[30] Danner, F.W. and Lonky, E. 1981. A Cognitive-Developmental Approach to the Effects of Rewards on Intrinsic Motivation. *Child Development*. (1981). DOI:https://doi.org/10.2307/1129110.

[31] Dean Burnett 2014. Motivational posters: do they actually work? *The Guardian*.

[32] Deci, E.L. et al. 1999. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological bulletin*.

[33] Deci, E.L. et al. 1999. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*.

[34] Deci, E.L. 1971. Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*. 18, 1 (1971), 105–115. DOI:https://doi.org/10.1037/h0030644.

[35] Deci, E.L. 1972. The effects of contingent and noncontingent rewards and controls on intrinsic motivation. *Organizational Behavior and Human Performance*. (1972). DOI:https://doi.org/10.1016/0030-5073(72)90047-5.

[36] Deci, E.L. and Cascio, W.F. 1972. Change in intrinsic motivation as a function of negative feedback and threats. *presented at Eastern Psychological Association Meeting,*. (1972).

[37] Deci, E.L. and Ryan, R.M. 1985. *Intrinsic Motivation and Self-Determination in Human Behavior*.

[38] Deci, E.L. and Ryan, R.M. 1980. The Empirical Exploration of Intrinsic Motivational Processes. L. Berkowitz, ed. Academic Press. 39–80.

[39] Deci, E.L. and Ryan, R.M. 2000. The "what" and "why" of Goal Pursuits: of Behavior Human Needs and the Self-determination. *Psychological Inquiry*. 11, 4 (2000), 227–268. DOI:https://doi.org/10.1207/S15327965PLI1104.

[40] Deighton-Smith, N. and Bell, B.T. 2018. Objectifying Fitness: A content and thematic analysis of #Fitspiration images on social media. *Psychology of Popular Media Culture*. (2018). DOI:https://doi.org/10.1037/ppm0000143.

[41] Demir, E. 2008. The field of design and emotion: Concepts, arguments, tools, and

current issues. *Metu Journal of the Faculty of Architecture*. 25, 1 (2008), 135–152.

[42] Design research and innovation: An interview with Don Norman: 2011. .

[43] Desmet, P. 2002. *Designing Emotions*.

[44] Desmet, P. and Hekkert, P. 2007. Framework of product experience. *International Journal of Design*. 1, 1 (2007), 57–66. DOI:https://doi.org/10.1162/074793602320827406.

[45] Dion, K. et al. 1972. What is beautiful is good. *Journal of Personality and Social Psychology*. (1972). DOI:https://doi.org/10.1037/h0033731.

[46] Douneva, M. et al. 2016. Effects of Different Website Designs on First Impressions, Aesthetic Judgements and Memory Performance after Short Presentation. *Interacting with Computers*. 28, 4 (2016), 552–567. DOI:https://doi.org/10.1093/iwc/iwv033.

[47] Dumas, A.-A. and Desroches, S. 2019. Women's Use of Social Media: What Is the Evidence About Their Impact on Weight Management and Body Image? *Current obesity reports*. 8, 1 (Mar. 2019), 18–32. DOI:https://doi.org/10.1007/s13679-019-0324-4.

[48] Duro, L. et al. 2019. How Does the Visual Aesthetics of Positively-framed Messages Impact Their Motivational Capacity? *Proceedings of the 31st European Conference on Cognitive Ergonomics* (New York, NY, USA, 2019), 162–167.

[49] Duro, L. et al. 2019. Visual Quotes : Does Aesthetic Appeal Influence How Perceived Motivating Text Messages Impact Short-Term Exercise Motivation ? (2019), 1–6.

[50] Duro, L. et al. 2020. *Visual quotes and physical activity tracking: Can aesthetic pleasure motivate our short-term exercise motivation?*

[51] Dutton, D. 2010. *The art instinct : beauty, pleasure, & human evolution*. Bloomsbury Press.

[52] Dutton, D. 2009. *The Art Instinct: Beauty, Pleasure, and Human Evolution*.

[53] Elavsky, S. et al. 2019. Mobile Health Interventions for Physical Activity, Sedentary Behavior, and Sleep in Adults Aged 50 Years and Older: A Systematic Literature Review. *Journal of Aging and Physical Activity*. (2019). DOI:https://doi.org/10.1123/japa.2017-0410.

[54] Etkin, J. 2016. The Hidden Cost of Personal Quantification. *Journal of Consumer Research*. 42, 6 (2016), 967–984. DOI:https://doi.org/10.1093/jcr/ucv095.

[55] Facebook encourages text statuses with new colored backgrounds: 2016. *https://techcrunch.com/2016/12/19/facebook-status-background-color/*. Accessed: 2018-02-27.

[56] Fardouly, J. et al. 2015. Social comparisons on social media: the impact of Facebook on young women's body image concerns and mood. *Body image*. 13, (Mar. 2015), 38–45. DOI:https://doi.org/10.1016/j.bodyim.2014.12.002.

[57] Fisher, C.D. 1978. The effects of personal control, competence, and extrinsic reward systems on intrinsic motivation. *Organizational Behavior and Human Performance*. (1978). DOI:https://doi.org/10.1016/0030-5073(78)90054-5.

[58] Fitness & activity tracker - Statistics & Facts: 2019. *https://www.statista.com/topics/4393/fitness-and-activity-tracker/#dossierSummary__chapter1*. Accessed: 2020-02-25.

[59] Fredrickson, B.L. 2001. The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions. *The American psychologist*. 56, 3 (2001), 218–26. DOI:https://doi.org/10.1037/0003-066X.56.3.218.

[60] Fredrickson, B.L. and Roberts, T.-A. 1997. OBJECTIFICATION THEORY Toward Understanding Women ' s Lived Experiences and Mental Health Risks. *Psychology of Women Quarterly*. (1997).

[61] Global Strategy on Diet, Physical Activity and Health: *https://www.who.int/dietphysicalactivity/pa/en/*. Accessed: 2020-02-24.

[62] van Gorp, T. and Adams, E. 2012. *Design for Emotion*.

[63] Gould, T. and Kemal, S. 2006. Kant's Aesthetic Theory: An Introduction. *The Journal of Aesthetics and Art Criticism*. (2006). DOI:https://doi.org/10.2307/431437.

[64] Gouveia, R. et al. 2015. How do we engage with activity trackers?: a longitudinal study of Habito. *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. SEPTEMBER (2015), 1305–1316. DOI:https://doi.org/10.1145/2750858.2804290.

[65] Grouzet, F.M.E. et al. 2004. From environmental factors to outcomes: A test of an integrated motivational sequence. *Motivation and Emotion*. (2004). DOI:https://doi.org/10.1007/s11031-004-2387-z.

[66] Hall, A. et al. 2015. Mobile Text Messaging for Health: A Systematic Review of Reviews. *Ssrn*. (2015). DOI:https://doi.org/10.1146/annurev-publhealth-031914-122855.

[67] Hamborg, K.-C. et al. 2014. The Interplay between Usability and Aesthetics: More Evidence for the "What Is Usable Is Beautiful" Notion. *Advances in Human-Computer Interaction*. (2014). DOI:https://doi.org/10.1155/2014/946239.

[68] Harper, B. and Tiggemann, M. 2008. The Effect of Thin Ideal Media Images on Women ' s Self-Objectification , Mood , and Body Image. (2008), 649–657.

DOI:https://doi.org/10.1007/s11199-007-9379-x.

[69] Hartmann, J. et al. 2007. Investigating attractiveness in web user interfaces. *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '07*. (2007), 387. DOI:https://doi.org/10.1145/1240624.1240687.

[70] Hassenzahl, M. 2008. Aesthetics in interactive products: Correlates and consequences of beauty. *Product Experience*. 287–302.

[71] Hassenzahl, M. 2004. The Interplay of Beauty, Goodness, and Usability in Interactive Products. *Human Computer Interaction*. 19, 4 (2004), 319–349. DOI:https://doi.org/10.1207/s15327051hci1904_2.

[72] Hassenzahl, M. and Monk, A. 2010. The Inference of Perceived Usability From Beauty. *Human-Computer Interaction*. 25, 3 (2010), 37–41. DOI:https://doi.org/10.1080/07370024201050013 9.

[73] Hassenzahl, M. and Tractinsky, N. 2006. User experience - A research agenda. *Behaviour and Information Technology*. 25, 2 (2006), 91–97. DOI:https://doi.org/10.1080/01449290500330331.

[74] Heidig, S. et al. 2015. Emotional design in multimedia learning: Differentiation on relevant design features and their effects on emotions and learning. *Computers in Human Behavior*. 44, (2015), 81–95. DOI:https://doi.org/10.1016/j.chb.2014.11.009.

[75] Henderlong, J. and Lepper, M.R. 2002. The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin*.

[76] Hewett, R. and Conway, N. 2016. The undermining effect revisited: The salience of everyday verbal rewards and self-determined motivation. *Journal of Organizational Behavior*. 37, 3 (2016), 436–455. DOI:https://doi.org/10.1002/job.2051.

[77] Hogue, J. V and Mills, J.S. 2019. The effects of active social media engagement with peers on body image in young women. *Body image*. 28, (Mar. 2019), 1–5. DOI:https://doi.org/10.1016/j.bodyim.2018.11.002.

[78] Hurling, R. et al. 2007. Using internet and mobile phone technology to deliver an automated physical activity program: Randomized controlled trial. *Journal of Medical Internet Research*. (2007). DOI:https://doi.org/10.2196/jmir.9.2.e7.

[79] Information sheet: global recommendations on physical activity for health 18 - 64 years old: 2011. *https://www.who.int/dietphysicalactivity/publications/recommendations18_64yearsold/en/*.

[80] Ingarden, R. and MacCormick, P.J. 1985. *Selected papers in aesthetics*. Philosophia-

Verl.

[81] Ingledew, D.K. and Markland, D. 2008. The role of motives in exercise participation. *Psychology and Health*. 23, 7 (2008), 807–828. DOI:https://doi.org/10.1080/08870440701405704.

[82] Isen, A.M. 2000. Some perspectives on positive affect and self-regulation. *Psychological Inquiry*. 11, November 2014 (2000), 184–187. DOI:https://doi.org/10.1207/S15327965PLI1103.

[83] Jakicic, J.M. et al. 2016. Effect of wearable technology combined with a lifestyle intervention on long-term weight loss: The IDEA randomized clinical trial. *JAMA - Journal of the American Medical Association*. (2016). DOI:https://doi.org/10.1001/jama.2016.12858.

[84] Jane, M. et al. 2018. Social media for health promotion and weight management: A critical debate. *BMC Public Health*. 18, 1 (2018), 1–7. DOI:https://doi.org/10.1186/s12889-018-5837-3.

[85] Jones, L.W. et al. 2003. … Effects of Source Credibility and Message Framing on Exercise Intentions, Behaviors, and …. *Journal of Applied Social Psychology*. (2003), 179–196.

[86] Jordan, P.W. 2000. *Designing Pleasurable Products*.

[87] Kant, I. 1952. *The critique of judgment*.

[88] Kaplan, R.M. and Stone, A.A. 2013. Bringing the Laboratory and Clinic to the Community: Mobile Technologies for Health Promotion and Disease Prevention. *Annual Review of Psychology*. 64, 1 (Jan. 2013), 471–498. DOI:https://doi.org/10.1146/annurev-psych-113011-143736.

[89] Karapanos, E. et al. 2016. Wellbeing in the making: Peoples' experiences with wearable activity trackers. *Psychology of Well-Being: Theory, Research and Practice*. 2013, (2016). DOI:https://doi.org/10.1186/s13612-016-0042-6.

[90] Kast, A. and Connor, K. 1988. Sex and Age Differences in Response to Informational and Controlling Feedback. *Personality and Social Psychology Bulletin*. (1988). DOI:https://doi.org/10.1177/0146167288143010.

[91] Kinnafick, F.E. et al. 2016. The effect of need supportive text messages on motivation and physical activity behaviour. *Journal of Behavioral Medicine*. 39, 4 (2016), 574–586. DOI:https://doi.org/10.1007/s10865-016-9722-1.

[92] Koka, A. and Hein, V. 2003. Perceptions of teacher's feedback and learning environment as predictors of intrinsic motivation in physical education. *Psychology of*

Sport and Exercise. (2003). DOI:https://doi.org/10.1016/S1469-0292(02)00012-2.

[93] Kurosu, M. et al. 1995. Apparent usability vs. inherent usability: experimental analysis on the determinants of the apparent usability. *Proceedings of the ACM Conference on Human Factors in Computing Systems*. (1995), 292–293. DOI:https://doi.org/10.1145/223355.223680.

[94] Langford, C.P. et al. 1997. Social support: a conceptual analysis. *Journal of advanced nursing*. 25, 1 (Jan. 1997), 95–100. DOI:https://doi.org/10.1046/j.1365-2648.1997.1997025095.x.

[95] Latimer, A.E. et al. 2010. A systematic review of three approaches for constructing physical activity messages : What messages work and what improvements are needed ? *International journal of behavioral nutrition and physical activity*. 7, (May 2010), 36. DOI:https://doi.org/10.1186/1479-5868-7-36.

[96] Lavie, T. and Tractinsky, N. 2004. Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human Computer Studies*. 60, 3 (2004), 269–298. DOI:https://doi.org/10.1016/j.ijhcs.2003.09.002.

[97] Lazar, A. et al. 2015. Why we use and abandon smart devices. *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing - UbiComp '15*. (2015), 635–646. DOI:https://doi.org/10.1145/2750858.2804288.

[98] Lee, S. and Koubek, R.J. 2010. Understanding user preferences based on usability and aesthetics before and after actual use. *Interacting with Computers*. 22, 6 (2010), 530–543. DOI:https://doi.org/https://doi.org/10.1016/j.intcom.2010.05.002.

[99] Lindgaard, G. et al. 2006. Attention web designers: You have 50 milliseconds to make a good first impression! *Behaviour & Information Technology*. 25, 2 (2006), 115–126. DOI:https://doi.org/10.1080/01449290500330448.

[100] Luhanga, E.T. et al. 2018. Identifying and Evaluating User Requirements for Smartphone Group Fitness Applications. *IEEE Access*. 6, January (2018), 3256–3269. DOI:https://doi.org/10.1109/ACCESS.2018.2793844.

[101] Lynch, C. et al. 2019. Changing the Physical Activity Behavior of Adults With Fitness Trackers: A Systematic Review and Meta-Analysis. *American Journal of Health Promotion*.

[102] Mammen, G. and Faulkner, G. 2013. Physical activity and the prevention of depression: a systematic review of prospective studies. *American journal of preventive medicine*. 45, 5 (Nov. 2013), 649–657. DOI:https://doi.org/10.1016/j.amepre.2013.08.001.

[103] Markland, D. and Tobin, V. 2004. A Modification to the Behavioural Regulation in

Exercise Questionnaire to Include an Assessment of Amotivation. *Journal of Sport and Exercise Psychology*. (2004). DOI:https://doi.org/10.1123/jsep.26.2.191.

[104] Miller, C. 2011. Aesthetics and e-assessment: The interplay of emotional design and learner performance. *Distance Education*. 32, 3 (2011), 307–337. DOI:https://doi.org/10.1080/01587919.2011.610291.

[105] Moorhead, S.A. et al. 2013. A new dimension of health care: Systematic review of the uses, benefits, and limitations of social media for health communication. *Journal of Medical Internet Research*. 15, 4 (2013), 1–17. DOI:https://doi.org/10.2196/jmir.1933.

[106] Moshagen, M. et al. 2009. A blessing, not a curse: Experimental evidence for beneficial effects of visual aesthetics on performance. *Ergonomics*. 52, 10 (2009), 1311–1320. DOI:https://doi.org/10.1080/00140130903061717.

[107] Moshagen, M. and Thielsch, M.T. 2010. Facets of visual aesthetics. *International Journal of Human-Computer Studies*. 68, 10 (2010), 689–709. DOI:https://doi.org/https://doi.org/10.1016/j.ijhcs.2010.05.006.

[108] Mouratidis, A. et al. 2010. How you provide corrective feedback makes a difference: The motivating role of communicating in an autonomy-supporting way. *Journal of Sport and Exercise Psychology*. (2010). DOI:https://doi.org/10.1123/jsep.32.5.619.

[109] Mouratidis, A. et al. 2008. The motivating role of positive feedback in sport and physical education: Evidence for a motivational model. *Journal of Sport and Exercise Psychology*. (2008). DOI:https://doi.org/10.1123/jsep.30.2.240.

[110] Munson, S. 2012. MIndfulness, Reflection, and Persuasion in Personal Informatics. *CHI 2012 Workshop*. (2012), 4.

[111] Munson, S. and Consolvo, S. 2012. Exploring Goal-setting, Rewards, Self-monitoring, and Sharing to Motivate Physical Activity. *Proceedings of the 6th International Conference on Pervasive Computing Technologies for Healthcare*. (2012), 25–32. DOI:https://doi.org/10.4108/icst.pervasivehealth.2012.248691.

[112] Nabi, R.L. et al. 2019. When audiences become advocates: Self-induced behavior change through health message posting in social media. *Computers in Human Behavior*. 99, July 2018 (2019), 260–267. DOI:https://doi.org/10.1016/j.chb.2019.05.030.

[113] Napolitano, M.A. et al. 2013. Using facebook and text messaging to deliver a weight loss program to college students. *Obesity*. 21, 1 (2013), 25–31. DOI:https://doi.org/10.1038/oby.2012.107.

[114] Nielsen, J. 1993. *Usability engineering*. Academic Press.

[115] Norman, D.A. 2002. Emotions & Attractive Design: Things Work Better. *Interactions*.

(2002), 36–42.

[116] Norman, D.A. 1990. *The design of everyday things.* MIT Press.

[117] Norman, D.N. 2004. *Emotional Design - Why we love (or hate) everyday things*.

[118] Organizatiob, W.H. 2010. *Global Recommendations on physical activity for health*.

[119] Organization, W.H. 2018. *Global Action Plan on Physical Activity 2018-2030: More Active People For a Healthier World*.

[120] Palan, S. and Schitter, C. 2018. Prolific.ac—A subject pool for online experiments. *Journal of Behavioral and Experimental Finance*. 17, (2018), 22–27. DOI:https://doi.org/https://doi.org/10.1016/j.jbef.2017.12.004.

[121] Peer, E. et al. 2017. Beyond the Turk: Alternative platforms for crowdsourcing behavioral research. *Journal of Experimental Social Psychology*. 70, (2017), 153–163. DOI:https://doi.org/https://doi.org/10.1016/j.jesp.2017.01.006.

[122] Perceived Competence Scales: *https://selfdeterminationtheory.org/perceived-competence-scales/*.

[123] Physical Activity: 2018. *https://www.who.int/news-room/fact-sheets/detail/physical-activity*. Accessed: 2020-02-24.

[124] Physical Activity and Health: *https://www.cdc.gov/physicalactivity/basics/pa-health/index.htm#ReducedCancer*. Accessed: 2020-02-24.

[125] Prestwich, A. et al. 2009. Can the effects of implementation intentions on exercise be enhanced using text messages? *Psychology and Health*. (2009). DOI:https://doi.org/10.1080/08870440802040715.

[126] Reber, R. et al. 2004. Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*. 8, 4 (2004), 364–382. DOI:https://doi.org/10.1207/s15327957pspr0804_3.

[127] Rodgers, W.M. et al. 2010. Becoming a regular exerciser: Examining change in behavioural regulations among exercise initiates. *Psychology of Sport and Exercise*. 11, 5 (2010), 378–386. DOI:https://doi.org/10.1016/j.psychsport.2010.04.007.

[128] Rogers, Y. et al. 2011. Interaction design : beyond human-computer interaction. J. Wiley & Sons.

[129] Runkeeper Instagram account: 2019. *https://www.instagram.com/runkeeper/?hl=pt*.

[130] Ryan, R.M. 1982. Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*. 43, 3 (1982), 450–461. DOI:https://doi.org/10.1037/0022-3514.43.3.450.

[131] Ryan, R.M. et al. 1997. Intrinsic Motivation and Exercise Adherence. *International*

Journal of Sport Psychology.

[132] Ryan, R.M. et al. 1983. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology*. (1983). DOI:https://doi.org/10.1037/0022-3514.45.4.736.

[133] Ryan, R.M. and Deci, E.L. 2017. Self-determination theory: Basic psychological needs in motivation, development, and wellness. *Self-determination theory: Basic psychological needs in motivation, development, and wellness.* Guilford Press.

[134] Ryan, R.M. and Deci, E.L. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*. 55, 1 (2000), 68–78. DOI:https://doi.org/10.1037/0003-066X.55.1.68.

[135] Ryan, R.M. and Powelson, C.L. 1991. Autonomy and relatedness as fundamental to motivation and education. *Journal of Experimental Education*. (1991). DOI:https://doi.org/10.1080/00220973.1991.10806579.

[136] S, F. 2011. The Social Life of Health Information, 2011: Peer-to-peer Healthcare. (2011).

[137] Sanders, E.B.-N. 1992. CONVERGING PERSPECTIVES: Product Development Research for the 1990s. *Design Management Journal (Former Series)*. 3, 4 (1992), 49–54. DOI:https://doi.org/10.1111/j.1948-7169.1992.tb00604.x.

[138] Sauer, J. and Sonderegger, A. 2009. The influence of prototype fidelity and aesthetics of design in usability tests: Effects on user behaviour, subjective evaluation and emotion. *Applied Ergonomics*. 40, 4 (2009), 670–677. DOI:https://doi.org/https://doi.org/10.1016/j.apergo.2008.06.006.

[139] Van Schaik, P. et al. 2012. User-Experience from an Inference Perspective. *ACM Trans. Comput.-Hum. Interact.* 19, 2 (2012), 11:1--11:25. DOI:https://doi.org/10.1145/2240156.2240159.

[140] Van Schaik, P. and Ling, J. 2009. The role of context in perceptions of the aesthetics of web pages over time. *International Journal of Human-Computer Studies*. 67, 1 (2009), 79–89. DOI:https://doi.org/http://dx.doi.org/10.1016/j.ijhcs.2008.09.012.

[141] Schenkman, B.N. and Jönsson, F.U. 2000. Aesthetics and preferences of web pages. *Behaviour & Information Technology*. 19, 5 (2000), 367–377. DOI:https://doi.org/10.1080/014492900750000063.

[142] Solso, R.L. 1997. *Cognition and the visual arts*. MIT.

[143] Sonderegger, A. et al. 2014. The Influence of Aesthetics in Usability Testing: The Case

of Dual-domain Products. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2014), 21–30.

[144] Sonderegger, A. and Sauer, J. 2010. The influence of design aesthetics in usability testing: Effects on user performance and perceived usability., Der Einfluss von aesthetischem Design beim Usability-Testing: Auswirkungen auf Benutzerverhalten und wahrgenommene Usability. *Applied Ergonomics*. 41, 3 (2010), 403–410.

[145] Standage, M. and Ryan, R.M. 2012. Self-determination theory and exercise motivation: facilitating self-regulatory processes to support and maintain health and well-being. *Advances in motivation in sport and exercise, 3rd edition*. G.C. Roberts and D.C. Treasure, eds. Human Kinetics. 233–270.

[146] Standing, L.G. 2004. Halo Effect. *The SAGE Encyclopedia of Social Science Research Methods*. SAGE Publications, Inc.

[147] Stephens, J. and Allen, J. 2013. Mobile phone interventions to increase physical activity and reduce weight: A systematic review. *Journal of Cardiovascular Nursing*.

[148] SW, B. et al. 2013. Physical Activity Text Messaging Interventions in Adults: A Systematic Review. *Worldviews on Evidence-Based Nursing*. (2013).

[149] Tatarkiewicz, W. and Harrel J. 1970. History of aesthetics. Volume 1, Volume 1,.

[150] Teixeira, P.J. et al. 2012. Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*. 9, 1 (Jun. 2012), 1. DOI:https://doi.org/10.1186/1479-5868-9-78.

[151] Teodoro, R. and Naaman, M. 2013. Fitter with Twitter: Understanding personal health and fitness activity in social media. *Proceedings of the 7th International Conference on Weblogs and Social Media, ICWSM 2013*. (2013), 611–620.

[152] Thielsch, M.T. et al. 2019. Experimental investigation on the effects of website aesthetics on user performance in different virtual tasks. *PeerJ*. 7, (2019), e6516. DOI:https://doi.org/10.7717/peerj.6516.

[153] Thüring, M. and Mahlke, S. 2007. Usability, aesthetics and emotions in human-technology interaction. *International Journal of Psychology*. 42, 4 (2007), 253–264. DOI:https://doi.org/10.1080/00207590701396674.

[154] Tractinsky, N. 1997. Aesthetics and apparent usability: Empirically assessing cultural and methodological issues. *Conference on Human Factors in Computing Systems*. (1997), 115–122. DOI:https://doi.org/10.1145/258549.258626.

[155] Tractinsky, N. et al. 2006. Evaluating the consistency of immediate aesthetic perceptions of web pages. *International Journal of Human Computer Studies*. (2006).

DOI:https://doi.org/10.1016/j.ijhcs.2006.06.009.

[156] Tractinsky, N. et al. 2000. What is beautiful is usable. *Interacting with Computers*. 13, 2 (2000), 127–145. DOI:https://doi.org/10.1016/S0953-5438(00)00031-X.

[157] Tseng, Y.-C. et al. 2018. The Different Effects of Motivational Messages and Monetary Incentives on Fostering Walking Behavior. *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*. (2018), LBW017:1--LBW017:6. DOI:https://doi.org/10.1145/3170427.3188670.

[158] Tuch, A.N. et al. 2012. Is beautiful really usable? Toward understanding the relation between usability, aesthetics, and affect in HCI. *Computers in Human Behavior*. 28, 5 (2012), 1596–1607. DOI:https://doi.org/10.1016/j.chb.2012.03.024.

[159] Um, E.R. et al. 2012. Emotional Design in Multimedia Learning. *Journal of Educational Psychology*. 104, 2 (2012), 485–498. DOI:https://doi.org/10.1037/a0026609.

[160] Updated exercise guidelines showcase the benefits to your heart and beyond: 2019. *https://www.health.harvard.edu/heart-health/updated-exercise-guidelines-showcase-the-benefits-to-your-heart-and-beyond*.

[161] Vallerand, R.J. and Reid, G. 1984. On the Causal Effects of Perceived Competence on Intrinsic Motivation: A Test of Cognitive Evaluation Theory. *Journal of Sport Psychology*. (1984). DOI:https://doi.org/10.1123/jsp.6.1.94.

[162] Van't Riet, J. et al. 2010. Investigating message-framing effects in the context of a tailored intervention promoting physical activity. *Health Education Research*. 25, 2 (2010), 343–354. DOI:https://doi.org/10.1093/her/cyp061.

[163] Vansteenkiste, M. and Deci, E.L. 2003. Competitively Contingent Rewards and Intrinsic Motivation: Can Losers Remain Motivated? *Motivation and Emotion*.

[164] Villalonga, C. et al. 2017. Ontological Modeling of Motivational Messages for Physical Activity Coaching. (2017).

[165] de Vries, R. 2018. *Theory-Based and Tailor-Made: Motivational Messages for Behavior Change Technology*.

[166] de Vries, R.A.J. et al. 2017. A word of advice: how to tailor motivational text messages based on behavior change theory to personality and gender. *Personal and Ubiquitous Computing*. 21, 4 (2017), 675–687. DOI:https://doi.org/10.1007/s00779-017-1025-1.

[167] de Vries, R.A.J. et al. 2016. Crowd-Designed Motivation. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16* (2016), 297–308.

[168] de Vries, R.A.J. et al. 2017. Experts Get Me Started, Peers Keep Me Going: Comparing Crowd- Versus Expert-designed Motivational Text Messages for Exercise Behavior

Change. *Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare*. (2017), 155–162. DOI:https://doi.org/10.1145/3154862.3154875.

[169] Wagemans, J. et al. 2012. A century of Gestalt psychology in visual perception: I. Perceptual grouping and figure–ground organization. *Psychological Bulletin*. 138, 6 (2012), 1172–1217. DOI:https://doi.org/10.1037/a0029333.

[170] Walter, A. 2012. *Designing for emotion*. A Book Apart.

[171] Warneken, F. and Tomasello, M. 2008. Extrinsic Rewards Undermine Altruistic Tendencies in 20-Month-Olds. *Developmental Psychology*. (2008). DOI:https://doi.org/10.1037/a0013860.

[172] Wilmot, E.G. et al. 2012. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*. 55, 11 (Nov. 2012), 2895–2905. DOI:https://doi.org/10.1007/s00125-012-2677-z.

[173] Wilson, P.M. et al. 2006. "It's who I am…really!" The importance of integrated regulation in exercise contexts. *Journal of Biobehavioral Research*. (2006). DOI:https://doi.org/10.1111/j.1751-9861.2006.tb00021.x.

[174] Wobbrock, J.O. et al. 2011. The Aligned Rank Transform for nonparametric factorial analyses using only ANOVA procedures. *Conference on Human Factors in Computing Systems - Proceedings* (2011).

[175] Yeh, Y. chu et al. 2015. Associated and dissociated neural substrates of aesthetic judgment and aesthetic emotion during the appreciation of everyday designed products. *Neuropsychologia*. 73, (2015), 151–160. DOI:https://doi.org/10.1016/j.neuropsychologia.2015.05.010.

[176] You can now add color to your Facebook posts: 2016. *https://thenextweb.com/facebook/2016/12/19/facebook-get-lot-colorful/*. Accessed: 2019-01-02.

[177] Zanuso, S. et al. 2010. Exercise for the management of type 2 diabetes: A review of the evidence. *Acta Diabetologica*. 47, 1 (2010), 15–22. DOI:https://doi.org/10.1007/s00592-009-0126-3.

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