

## Building a value proposition for concussion patients.

**Auteur :** Halin, Anaïs

**Promoteur(s) :** Surlemont, Bernard

**Faculté :** HEC-Ecole de gestion de l'Université de Liège

**Diplôme :** Master en sciences de gestion, à finalité spécialisée en management général (Horaire décalé)

**Année académique :** 2019-2020

**URI/URL :** <http://hdl.handle.net/2268.2/10881>

---

### Avertissement à l'attention des usagers :

Tous les documents placés en accès ouvert sur le site le site MatheO sont protégés par le droit d'auteur. Conformément aux principes énoncés par la "Budapest Open Access Initiative"(BOAI, 2002), l'utilisateur du site peut lire, télécharger, copier, transmettre, imprimer, chercher ou faire un lien vers le texte intégral de ces documents, les disséquer pour les indexer, s'en servir de données pour un logiciel, ou s'en servir à toute autre fin légale (ou prévue par la réglementation relative au droit d'auteur). Toute utilisation du document à des fins commerciales est strictement interdite.

Par ailleurs, l'utilisateur s'engage à respecter les droits moraux de l'auteur, principalement le droit à l'intégrité de l'oeuvre et le droit de paternité et ce dans toute utilisation que l'utilisateur entreprend. Ainsi, à titre d'exemple, lorsqu'il reproduira un document par extrait ou dans son intégralité, l'utilisateur citera de manière complète les sources telles que mentionnées ci-dessus. Toute utilisation non explicitement autorisée ci-avant (telle que par exemple, la modification du document ou son résumé) nécessite l'autorisation préalable et expresse des auteurs ou de leurs ayants droit.

---

# **BUILDING A VALUE PROPOSITION FOR CONCUSSION PATIENTS**

Promoteur:

Bernard SURLEMONT

Lecteurs:

Julien PAESCHEN

Aurore THIBAUT

Travail de fin d'études présenté par

**Anaïs HALIN**

en vue de l'obtention du diplôme de  
Master en sciences de gestion, à finalité  
spécialisée en management général

Année académique 2019/2020



## ACKNOWLEDGEMENTS

I express my most sincere and deepest thanks to the people who helped me in carrying out this work.

First, I would like to thank Mr Bernard Surlemont, Professor at HEC Liège. As promotor of this master thesis, he guided me in my work and gave me precious advice. I also thank Prof. Julien Paeschen for agreeing to be the first reader and offering his help.

I would also like to thank Prof. Steven Laureys, neurologist at the Liège University Hospital and director of the Coma Science Group, for his availability, his kindness, and for giving me the opportunity to work on this fascinating subject. I also thank his team at the Giga, and, in particular, Dr Aurore Thibaut who accepted to be part of my jury and who was available whenever I needed her help.

I am furthermore grateful to all the people who made this work possible by agreeing to be interviewed or by participating to the co-creation workshop, in particular, Mr Frederic Ooms who agreed to facilitate the meeting, and Dr Nicolas Lejeune for his participation and expertise as a neurologist.

I also take this opportunity to thank Mr François Arcadipane and Mr Hubert Brogniez for the collaboration to the Mind-Care project.

Finally, many thanks to Mr Romain Mathonet for proofreading this work.

Anaïs HALIN



## ABSTRACT

Traumatic brain injuries are considered a critical public health issue with approximately 30,000 people suffering from it every year in Belgium. Concussion, which is the most common form of traumatic brain injury, is usually not life-threatening, but it can nevertheless cause serious problems and is often misunderstood. Most patients recover from a concussion relatively quickly and can return to their life within a few days or weeks. However, some patients experience post-concussion symptoms for weeks, months, or even years sometimes, and this can have numerous consequences on their daily life, relationships, or ability to resume usual activities.

The aim of this work is to build a value proposition for concussion patients, by first identifying their problems and needs, and then finding solutions to their key problems. The first step consists in a literature search on concussions in order to be able to understand and empathize with concussion patients. The second step is to collect information to identify their real needs and gain a deep understanding through interviews. The third step is to synthesize all insights and define the key problems to solve, by analyzing all the information gathered from the interviews. This step gives rise to the customer profile. The next step is to generate ideas in a co-creation workshop, and, finally, to map a value proposition that achieves a fit with the customer profile. The value proposition is based on the needs of information of concussion patients.

**Keywords:** Value proposition, concussion patients, customer profile, value map



## RÉSUMÉ

Les traumatismes crâniens sont considérés comme un problème de santé publique critique avec environ 30 000 personnes qui en souffrent chaque année en Belgique. La commotion cérébrale, qui est la forme la plus courante de traumatisme crânien, ne met généralement pas la vie en danger, mais elle peut néanmoins causer de graves problèmes et est souvent mal comprise. La plupart des patients se remettent relativement rapidement d'une commotion cérébrale et peuvent reprendre leur vie en quelques jours ou semaines. Cependant, certains patients ressentent des symptômes post-commotionnels pendant des semaines, des mois, voire des années parfois, et cela peut avoir de nombreuses conséquences sur leur vie quotidienne, leurs relations ou leur capacité à reprendre leurs activités habituelles.

L'objectif de ce travail est d'élaborer une proposition de valeur pour les patients ayant subi une commotion cérébrale, en identifiant d'abord leurs problèmes et leurs besoins, puis en trouvant des solutions à leurs principaux problèmes. La première étape est de réaliser une recherche documentaire afin de pouvoir comprendre les patients ayant subi une commotion cérébrale et de leur témoigner de l'empathie. La deuxième étape consiste à collecter des informations pour identifier leurs besoins réels et acquérir une compréhension approfondie grâce à des interviews. La troisième étape consiste à synthétiser toutes les idées et à définir les principaux problèmes à résoudre, en analysant toutes les informations recueillies lors de ces entretiens. Cette étape donne lieu au profil client. L'étape suivante consiste à générer des idées lors d'un atelier de co-création et, enfin, à réaliser la carte de valeur en adéquation avec le profil client. La proposition de valeur est basée sur les besoins d'information des patients souffrant de commotions cérébrales.

**Mots clés:** Proposition de valeur, commotion cérébrale, profil client, carte de valeur





# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Motivation . . . . .	1
1.2	Research question and objectives . . . . .	2
1.3	Limitations . . . . .	3
<b>2</b>	<b>Traumatic brain injury</b>	<b>5</b>
2.1	Definition and outcome . . . . .	5
2.2	Causes and risk factors . . . . .	6
2.3	Diagnosis and classification . . . . .	6
2.4	Disability and recovery . . . . .	8
2.5	Symptoms . . . . .	9
2.6	Treatments and rehabilitation . . . . .	10
2.7	Costs . . . . .	12
2.8	Prevention . . . . .	12
<b>3</b>	<b>Methodology</b>	<b>13</b>
3.1	Value proposition canvas . . . . .	13
3.1.1	Customer profile . . . . .	15
3.1.1.1	Building the customer profile . . . . .	16
3.1.2	Value map . . . . .	17
3.1.2.1	Mapping the value proposition . . . . .	18
3.1.3	Fit . . . . .	20
<b>4</b>	<b>Results and analyses</b>	<b>23</b>
4.1	Results of the interviews: building the customer profile . . . . .	23

4.1.1	Jobs . . . . .	24
4.1.2	Pains . . . . .	30
4.1.3	Gains . . . . .	35
4.2	Results of the co-creation workshop: building the value map . . . . .	38
4.2.1	Definition of the problem statement . . . . .	39
4.2.2	Brainstorming . . . . .	39
4.2.3	Prioritization of ideas . . . . .	41
4.2.4	Building the value map . . . . .	41
4.2.5	Checking the problem-solution fit . . . . .	45
<b>5</b>	<b>Conclusion</b>	<b>49</b>
<b>A</b>	<b>Interview guide for concussion patients</b>	<b>51</b>
<b>B</b>	<b>Problem mapping</b>	<b>53</b>
	<b>References</b>	<b>55</b>

# Chapter 1

## Introduction

### 1.1 Motivation

In Belgium, approximately 30,000 people suffer from traumatic brain injury (TBI) of varying severity every year (Agence pour une Vie de Qualité (AVIQ), 2020). Around the world, there are nearly 200 hospitalisations for head trauma per 100,000 inhabitants each year, making it a critical public health issue. Of those affected, about 10% suffer from severe after-effects. TBI can affect everyone, in particular children, young adults and elderly people (World Health Organization, 2020).

The most common form of TBI is concussion, which is often referred to as mild TBI because concussions are usually not life-threatening. However, they still can cause serious problems, and research suggests that repeated concussions can be particularly dangerous (Bonnechere, Beauthier, Rooze, & Van Sint Jan, 2015; Powell, 2001; McAlister & McCrea, 2017). The World-renowned neurologist Steven Laureys promotes awareness of the long-term effects of repeated blows to the head in sport in his TEDx talk on brain concussion entitled "Shake it and you break it" (Laureys, 2016). A well-known example of the impact that repeated blows to the head can have is that of the American professional boxer Muhammad Ali diagnosed with Parkinson's syndrome at the age of only 42.

Concussions are a serious and often misunderstood injury. They are underdiagnosed (Kimbler, Murphy, & Dhandapani, 2011), and this is particularly true in Europe, where there is a lack of knowledge and risk awareness. In North America, awareness is growing due to sports such as American football, ice hockey, or boxing. Recent high-profile stories about athletes taking extended breaks from their careers to recover from concussions have helped to start a public discussion about how serious a concussion can be, and how to recognize the symptoms (The Ottawa hospital, 2020). According to experts, concussions are difficult to diagnose because they are accompanied by a wide range of symptoms and are rarely detected by diagnostic tests such as magnetic resonance imaging (MRI) and computed tomography (CT) scans.

Most patients recover from a concussion relatively quickly and can return to the life that was theirs before the injury. But, unfortunately, not everyone does. Some patients experience post-concussion symptoms for weeks, months, even years sometimes, and some will simply have to live with it for the rest of their lives (Pearce, 2019). Post-concussion symptoms can have numerous consequences on a person's daily life, relationships with others, or ability to resume usual activities (Ontario Neurotrauma Foundation (ONF), 2017). Indeed, the physical, cognitive, and emotional difficulties after a concussion are an obstacle to moving on. The best way for patients to contribute to their recovery is patience. Indeed, patients can become frustrated with their recovery and eager to return to their activities, and when they do so hastily, it is often at the expense of an intensification of symptoms (The Ottawa hospital, 2020). Many years of productive life are lost, and many people have to suffer years of disability after brain injury. TBI is indeed the leading cause of death and disability in children and young adults around the world. In addition, it engenders great economic costs for individuals, families and society (World Health Organization, 2020).

## **1.2 Research question and objectives**

In 2014, Alex Osterwalder sadly realized that, every day, companies were designing products and services to improve their customers lives but 72% of new product and service innovation were failing to deliver on expectations (Strategyzer, 2020). This means that customers did not care about seven out of ten new products introduced to the

market. Therefore, he came to the conclusion that, before creating value for the business with a business model canvas, it is crucial to create value for customers. Alberto Savoia made the same sad observation in 2011 when he wrote his book *Pretotype it : Make sure you are building the right it before you build it right* (Savoia, 2011). Therefore, the first concern should be to find the "right it", the product or service the customer care about in order to create value for them. This can be achieved by filling the value proposition canvas.

The aim of this work is to answer the following research question: How to create value for concussion patients? This will be tackled by answering to two sub-questions:

- What are the problems and needs of concussion patients?
- What are the solutions to their key problems?

Therefore, the first step is to be able to understand and empathize with concussion patients. This requires to acquire knowledge about concussions through a literature search. Chapter 2 provides information about concussion, and, more broadly, about traumatic brain injury. The second step is to collect information to identify the real needs of concussion patients. Chapter 3 explains the methodology that has been used for this purpose. The next step is to synthesize all insights and define the key problems to solve. Chapter 4 gives the results and analyses the collected information. In order to actually find some solutions to the identified problems, the last step is to generate ideas and develop value propositions. The methodology and results are also presented in chapter 3 and chapter 4 respectively.

## 1.3 Limitations

While this work intends to create value for concussion patients, the full business model will not be developed. The value propositions will not be prototyped nor tested. Thus, if we rely on the five-stage process of design thinking as defined by the Stanford d.school (Hasso Plattner Institute of Design at Stanford (d.school), 2010) illustrated in Figure 1.1, this work addresses the first three phases out of the five :

1. Empathise with the customers;

2. Define the customers' needs, problems, and define the insights;
3. Ideate by challenging assumptions and creating ideas for innovative solutions;
4. Prototype to start creating solutions;
5. Test solutions.

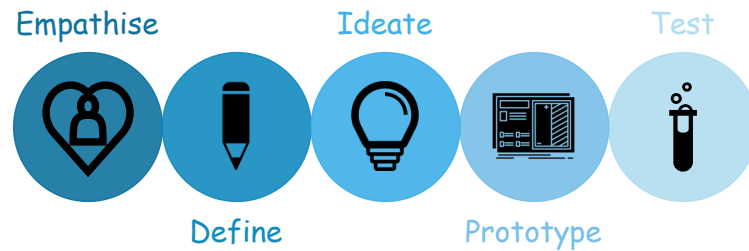


Figure 1.1: The five phases of Design Thinking.

Indeed, the Customer Development principle<sup>1</sup> of Steve Blank (Blank, 2005) who inspired the Lean Startup principle<sup>2</sup> of Eric Ries (Ries, 2011) has been integrated into the value proposition canvas of Alex Osterwalder (Osterwalder, 2012; Blank, 2014). Therefore, by applying this principle to the value proposition canvas, it is possible to iterate over the value propositions by testing, adjusting, redesigning them to finally build a minimum viable product (MVP) and test it. However, this is beyond the scope of this work.

<sup>1</sup>Steve Blank analysed, invented and structured what he calls the "customer development process", a true 4-step process, which he contrasts with the traditional "product development process" approach. Instead of starting the process on the development of the product and then on its use by customers, the idea is to start with the development of knowledge about customers. The four steps are the customer discovery, customer validation, customer creation, and company building.

<sup>2</sup>Eric Ries launched the Lean Startup movement based on Steve Blank's customer development process. The idea is to eliminate slack and uncertainty from product development by continuously building, testing, and learning in an iterative process. The Lean Startup movement therefore encourages to rapidly build prototypes, called minimum viable products (MVP) (Blank, 2013).

# **Chapter 2**

## **Traumatic brain injury**

This chapter defines concussion, and more generally, traumatic brain injury. It gives its outcome, causes, and risk factors. It explains how the diagnosis is made. It gives some details about the recovery, symptoms, treatments, and rehabilitation. Finally, this chapter ends with a few words about costs related to TBI and prevention.

### **2.1 Definition and outcome**

A traumatic brain injury (TBI) is defined as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury (Centers for Disease Control and Prevention, 2019). If the head is hit by an external mechanical force or if the head undergoes a sudden acceleration or deceleration, the brain can be displaced inside the skull and be injured. All grades of injury can occur, ranging from no visible abnormality of the brain in cases of mild TBI to superficial bruising, and, in severe cases, torn tissues, bleeding or other physical damage to the brain. These injuries can result in long-term complications, coma, or even death.

Outcome of TBI, in terms of mortality rates and disability, is influenced by many factors such as the pre-injury status (age, health, and psychosocial function), the initial clinical grade immediately after injury reflecting the primary brain damage, complications and secondary brain damage that may develop within minutes of the impact, acute management in hospital, and rehabilitation. In case of mild TBI, the mortality rate is



below 1%, while 20–50% die after suffering a severe TBI. The intermediate category, referred to as moderate TBI, implies a mortality rate of 2–5%. Disability is a common problem after hospitalization for TBI, even after a mild event (World Health Organization, 2020).

## 2.2 Causes and risk factors

A concussion, also known as mild TBI, can occur whenever your brain moves within your skull as a result of a direct hit or force to the head, face, neck, or other part of the body. Therefore, shaking the head too hard, like what happens during whiplash, can also cause concussion. Falls, collisions, road accident, contact in sports, or being hit by an object or person are some examples of actions that can cause concussion (Ontario Neurotrauma Foundation (ONF), 2017). TBI can therefore affect everyone. It can happen to anyone, anywhere, at anytime.

The people most at risk of traumatic brain injury include (Mayo Clinic, n.d.):

- children, especially newborns to 4-year-olds;
- young adults, especially those between ages 15 and 24;
- adults age 60 and older;
- males in any age group.

A previous concussion is probably the most important factor affecting the risk of a new concussion. The same is true for repetitive blows to the head. In this regard, contact sports such as boxing are associated with a much higher risk of long-term concussive damage from direct hits to the head.

## 2.3 Diagnosis and classification

In cases where a blow to the head is reported and when superficial wounds can be identified, the diagnosis of a TBI can be clear-cut. However, TBI may be present without any superficial signs of a head injury, making the diagnosis much less obvious.

Points awarded	Eye opening	Verbal response	Motor response
1	None	None	None
2	To pain	Sounds (incomprehensible)	Extends
3	To speech	Words (inappropriate)	Abnormal flexion
4	Spontaneous	Confused	Withdraws
5		Orientated	Localizes pain
6			Obeys commands

Table 2.1: Glasgow Coma Scale (GCS) to evaluate brain injury.

Classification of the brain injury can be made in order to evaluate prognosis, identify patients at risk for deterioration and choose appropriate observation and treatment. Initial classification of TBI is based mostly upon the clinical examination which is carried out by the physician in emergency department. Around 90% of TBIs are classified as mild, implying that the patient is awake but may have had a loss of consciousness and/or a short amnesia. Only 3–5% are severe TBIs, meaning that the patient is unconscious upon admission (World Health Organization, 2020).

As shown in Table 2.1, the Glasgow Coma Scale (GCS) uses a points system to evaluate the best ocular, verbal and motor responses. First, it measures the ability to open eyes, including whether the person opens his or her eyes only when asked. Secondly, it measures the ability to speak, such as whether the person speaks normally, speaks in a way that does not make sense, or does not speak at all. And, finally, the ability to move, ranging from moving arms easily to not moving even in response to painful stimulation. A normal healthy person will obtain a GCS score (adding up the eye opening score, the verbal score and the motor score) of 15. Someone who opens his eyes only after painful stimulation, utters only incomprehensible sounds and withdraws his hand only after pinching will be given a score of 8. This scale permits the following classification of TBI after clinical examination:

- mild head injury (GCS 13–15);
- moderate head injury (GCS 9–12);
- severe head injury (GCS 3–8).

However, there may be no correlation between initial GCS score and the person's short or long-term recovery or abilities.

Classification into these categories based on clinical assessment can be supported by the results of a computerized tomography (CT) examination, or a skull X-ray if a CT scanner is not available. A CT scan reveals a skull fracture more clearly than an ordinary X-ray examination will do. In addition, it visualizes the bleeding, bruising and swelling of actual brain injury. CT signs of brain damage are present in one third of the mild cases, two thirds of the moderate cases and all the severe cases (World Health Organization, 2020). However, performing a CT scan for every concussion patient is not recommended because it exposes patients to high levels of radiation and it is expensive. Moreover, only very few of them are at risk of cerebral hemorrhage, and the results are negative in most cases (Groenendaels, 2019; KCE (Centre Fédéral d'Expertise des Soins de Santé), 2016). Magnetic resonance imaging (MRI) can also be used to demonstrate the existence of lesions that were not detected on the CT scan after the person has been stabilized because it is difficult to transport an acutely-injured patient from the emergency room to the MRI scanner, or if symptoms do not improve soon after the injury (Mayo Clinic, n.d.; American Association of Neurological Surgeons (AANS), n.d.). This information is generally more useful for determining prognosis than for influencing treatment.

## 2.4 Disability and recovery

Traumatic brain injury is the leading cause of disability in people under 40 years of age (World Health Organization, 2020). Disability can be classified in a simple fashion using the Glasgow Outcome Scale (see Table 2.2).

According to the World Health Organization, about 90% of traumatic brain injury patients sustain a mild head injury, while a few suffer a moderate (5%) or severe (3%) brain injury. Half of the survivors are disabled after mild or moderate TBI, while three quarters of survivors are disabled after a severe injury. Although disability after mild TBI may have been underestimated, many patients make a good recovery with provision of appropriate information and without requiring additional specific interventions. But

Classification (GOS level)	Description
Dead	
Persistent vegetative state	Awake but not aware
Severely disabled	Conscious but dependent
Moderately disabled	Independent but disabled
Good recovery	May have minor sequelae

Table 2.2: Glasgow Outcome Scale (GOS).

one third of them are less lucky and fail to achieve a good recovery, even among young patients with mild injuries and a good pre-injury status. Some patients continue to recover for years after a TBI, but 90% reach their definitive GOS level after six months.

For a mild TBI or concussion, most people recover within a few days or weeks. Symptoms typically resolve in 1 to 3 months. In fewer cases, symptoms can last longer than that. Symptoms that last longer than 3 months are referred to as "prolonged symptoms" or "persistent post-concussion symptoms". However, just because symptoms last more than 3 months does not mean that they will not get better (Ontario Neurotrauma Foundation (ONF), 2017).

## 2.5 Symptoms

Traumatic brain injury can have wide-ranging physical and psychological effects. Some signs or symptoms may appear immediately after the traumatic event, while others may appear days or weeks later. Symptoms can last for days, weeks, or even longer. Some people may experience only one symptom and others may experience many. Symptoms of a concussion may include (The Ottawa hospital, 2020; Mayo Clinic, n.d.; National Institutes of Health (NIH), 2016):

- physical symptoms such as loss of consciousness, headache, nausea or vomiting, fatigue or drowsiness, slurred speech, sleep disturbances, dizziness, loss of balance or coordination;

- sensory symptoms such as blurred vision, sensitivity to light, ringing in the ears, changes in taste or smell;
- cognitive or mental symptoms such as amnesia or memory problem, concentration problems, irritability or mood swings

The Rivermead Post-Concussion Symptoms Questionnaire (RPQ) is a self-report scale to measure the severity of post-concussive symptoms following a TBI. The questionnaire was presented in 1995 by a group led by N. King (King, Crawford, Wenden, Moss, & Wade, 1995). The test, which can be self-administered or completed by interview, asks patients to rate the severity of 16 different symptoms commonly found after a mild TBI, grouped into three categories: physical, cognitive, and behavioral symptoms. Patients are asked to rate how severe each of the 16 symptoms has been over the past 24 hours compared to their pre-injury symptoms. These symptoms are reported by severity on a 5-point scale: not experienced, no more of a problem, mild problem, moderate problem, and severe problem. The RPQ is easy and quick to administer.

## 2.6 Treatments and rehabilitation

According to the World Health Organization, many of the mild cases can be classified as “minor head injuries”. These patients can be dismissed after a short clinical examination and adequate information, since their risk of further problems will be very low (less than 0.1%). Patients, when discharged, should be informed, preferably in writing, about:

- warning signs indicating possible complications;
- how normal and mild symptoms are expected to develop;
- how to resume normal daily activities.

The remaining patients with mild TBI have a 1-6% risk of deterioration. A closer examination may be required to identify the individuals with the highest risk of developing complications. The clinical examination, a CT scan and, in some cases, observation in a hospital ward will identify the very few patients in this group requiring treatment by a qualified neurosurgeon.

Concussion in most cases may not require specific treatment other than rest and pain relievers to treat a headache (Mayo Clinic, n.d.). Nevertheless, a person with a mild TBI usually needs to be monitored closely at home for any persistent, worsening or new symptoms. He or she may also have follow-up doctor appointments. It is very important to follow the instructions of healthcare providers for complete rest and gradual return to normal activities. If a person resumes normal activities and starts experiencing TBI symptoms, the healing and recovery process may take much longer than if he or she had followed the instructions. In addition, alcohol and other drugs can slow recovery and increase the chances of re-injury. Certain activities, like working on a computer and concentrating hard, can tire the brain even though they are not physically demanding. The concussion patient might need to reduce these kinds of activities or might need to rest between periods of such activities to let the brain rest. The doctor will indicate when a return to work, school or recreational activities is appropriate. In the meantime, it is best to limit physical or cognitive activities that make things worse until the doctor advises otherwise. Most people return to their normal routines gradually.

People experiencing mild TBI may require rehabilitation. The goal is to improve their abilities to perform daily activities. It makes it possible to recover certain functions, or even to implement strategies to get around the difficulties. This re-education is built according to the particular difficulties of the person, his/her preserved capacities, his/her needs in daily life, and many other parameters. The type and duration of rehabilitation is different for everyone. Some patients may need it for several years. Rehabilitation specialists may include (Mayo Clinic, n.d.):

- Physiatrist, a doctor trained in physical medicine and rehabilitation, who oversees the entire rehabilitation process, manages medical rehabilitation problems and prescribes medication as needed;
- Occupational therapist, who helps the person learn, relearn or improve skills to perform everyday activities;
- Physiotherapist, who helps with mobility and relearning movement patterns, balance and walking;
- Neuropsychologist, who assesses cognitive impairment and performance, helps the person manage behaviors or learn coping strategies, and provides psychotherapy as needed for emotional and psychological well-being;

- Speech and language pathologist, who helps the person improve communication skills and use assistive communication devices if necessary for the most severe TBI.

## 2.7 Costs

TBI-associated costs can be subdivided as follows:

- direct costs: hospitalization, outpatient care, rehabilitation;
- indirect costs: lost productivity;
- intangible costs to patients, families and friends: related to death or reduced quality of life.

## 2.8 Prevention

Prevention of concussions comes in two forms (MEES, 2015): the prevention of injury, and the promotion of safety. The prevention of injury includes both interventions made to prevent the potentially hazardous event from occurring, and interventions made to eliminate or reduce the severity of injuries once the event has occurred. The promotion of safety involves efforts to change structures, environment, management, attitudes, and behaviours related to safety. These efforts may lead to the adoption of measures of an informative, educational, incentive or legislative nature, for example. The World Health Organization (World Health Organization, 2020) recommends more efficient prevention through educational activities such as personal computer games, medical and paramedical training in neurotrauma, or multimedia educational campaigns on safety of motor vehicles, as road accidents are one of the leading causes of TBI. Moreover, according to them, the creation of foundations for the relatives of victims of injuries or associations for education and the prevention of TBI should be strengthened.

# Chapter 3

## Methodology

In order to answer the research question, this work relies on the value proposition canvas that is build conducting interviews on one side and using creativity techniques, in particular brainstorming, on the other. This chapter presents the theoretical background concerning the value proposition canvas, explains how the interviews have been conducted in order to build the customer profile, and, finally, gives the approach conducted to build the value map in order to achieve a fit.

### 3.1 Value proposition canvas

Alex Osterwalder *et al.* wrote a book called *Value proposition design* (Osterwalder, Pigneur, Bernarda, & Smith, 2014) which introduces the value proposition canvas, a tool that aims to design and test great value propositions in an iterative search for what customers want. The value proposition canvas perfectly integrates with the business model canvas and the environment map, two tools that are discussed in detail in *Business model generation* (Osterwalder & Pigneur, 2010), a previous book of Alex Osterwalder. Together, they shape the foundation of a suite of business tools. Whereas the environment map helps to understand the context and the business model canvas helps to create value for the business, the value proposition canvas helps to create value for the customer. The value proposition canvas (Figure 3.2) actually zooms into the details of two of the building blocks of the business model canvas (Figure 3.1) : the value proposition and the customer segment.



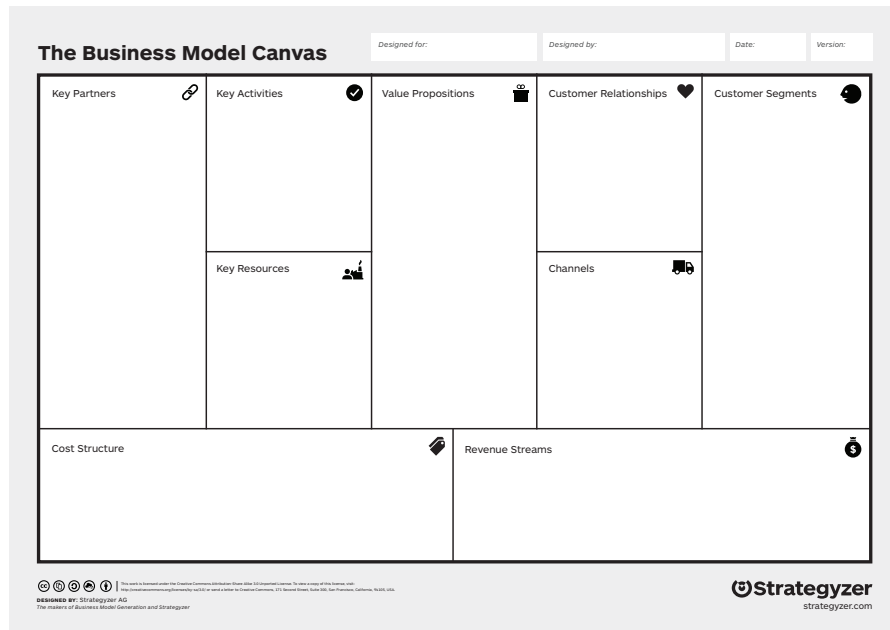


Figure 3.1: The business model canvas.

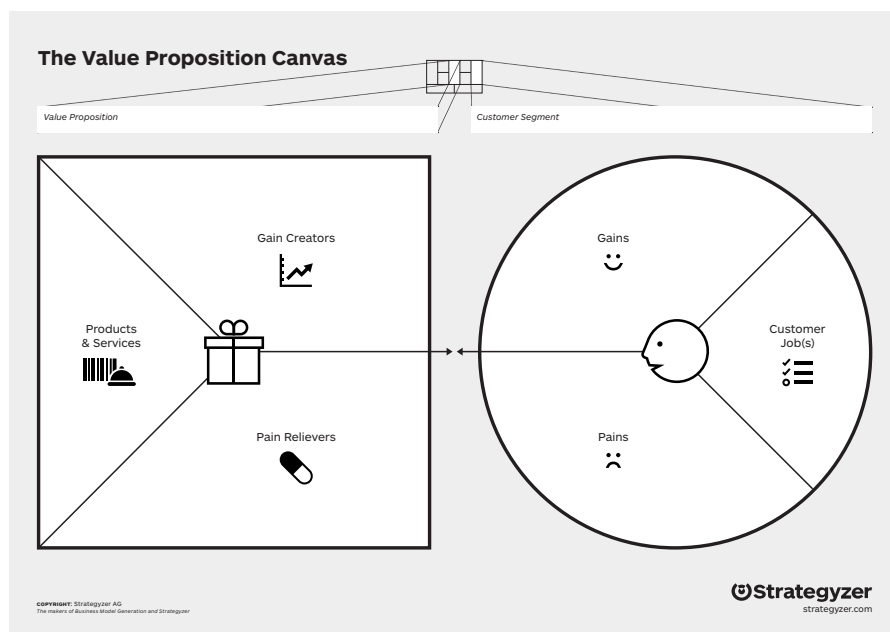


Figure 3.2: The value proposition canvas.

The value proposition canvas is thus made of two elements: the value (proposition) map and the customer (segment) profile. The customer profile aims to clarify the customer understanding, and the value map describes how to create value for that customer. Fit is achieved between the two when one meets the other.

### 3.1.1 Customer profile

The customer (segment) profile describes a specific customer segment of the business model canvas in a more structured and detailed way. It breaks the customer down into its jobs, pains, and gains. The customer jobs component describes what customers are trying to get done in their work and in their lives, as expressed in their own words. The pains component describes bad outcomes, risks, and obstacles related to customer jobs. Finally, the gains component describes the outcomes customers want to achieve or the concrete benefits they are seeking.

A customer job could be the tasks they are trying to perform and complete, the problems they are trying to solve, or the needs they are trying to satisfy. Jobs can have a functional, social or personal/emotional intent. Some jobs might be crucial and others trivial for the customers. Therefore, the importance of the jobs needs to be acknowledged and the jobs need to be classified from the most important to the most insignificant.

The pains describe anything that annoys the customers before, during and after getting a job done. This could be undesired costs and situations, negative emotions, or risks. The customer pains can be classified into three types : first, undesired outcomes, problems, and characteristics; second, obstacles; finally, risks, which are undesired potential outcomes. Again, some customer pains might be severe, whereas others might be light. Therefore, the customer pains need to be classified according to the severity, from the most extreme to the most moderate.

The gains describe the outcomes and benefits the customers require, expect, desire or would be surprised by. Gains include functional utility, social gains, positive emotions and cost savings. Again, some outcomes and benefits might be more relevant to customers than others. Therefore, the customer gains need to be classified according to the

relevance, from the most essential to the most "nice to have".

### **3.1.1.1 Building the customer profile**

In order to establish the customer profile, information needs to be collected to identify the customer's real needs. This is achieved by asking questions and listening to customers in qualitative semi-structured interviews.

The customer we want to satisfy and understand in this work is the concussion patient. Therefore, anyone who has experienced a concussion once in his/her life was eligible to be interviewed. However, we wanted the sample to be as diverse as possible as respect to the age, the gender, the severity and the date of the concussion (in order to take into consideration short-term as well as long-term effects), and the working status (so that potential issues related to school or work could be identified).

In order to get in touch with the concussion patients, various methods were used. Unfortunately, some of them have not proven to be effective. First, the help from traumatic brain injury associations and organisations has been requested. However, they were unable to provide their help since they are mainly involved with people who have suffered severe brain injuries. The department of Physical Medicine and Rehabilitation from several hospital were contacted. Finally, a post was published and massively shared on social medias. Note that the number of interviews to be carried has not been predefined. Interviews were conducted until information saturation was observed.

The semi-structured interviews were conducted following an interview guide which can be found in Appendix A. Given the current Covid-19 sanitary crisis, the interviews were conducted over the phone. First, a short introduction and presentation of this work were given. It was systematically specified that the interviews were anonymous, and the permission to record the conversation was requested. The interview guide is first composed of a short quantitative questionnaire which aims to characterize the sample. The first part is thus made up of closed-ended questions allowing the analysis of the sample and the appreciation of its diversity. These are then followed by open-ended questions aiming at understanding the problems and needs of patients. The questions

focus on their jobs, pains, and gains as defined in the customer profile of the value proposition canvas. Spontaneous responses to the questions were first expected. The patients were asked to develop their ideas, and new questions were eventually added to the ones present in the interview guide in order to go deeper into interesting interventions. When the patients were out of ideas, a map of the problems they were likely to encounter was used to guide the discussion in order to make sure to go over everything. However, special care was taken to be as neutral as possible in order not to influence the patients' answers. The problem mapping used can be found in the Appendix B. It was inspired by the family needs' questionnaire (FNQ) which is used to assess the needs, the quality of life and the psychological state of relatives of patients with severe traumatic brain injury such as patient with locked-in syndrome (LIS) (Lugo, Pellas, Blandin, Laureys, & Gosseries, 2017). This questionnaire encompasses 40 statements of needs which are divided into six subscales: health information, emotional support, instrumental support, professional support, community support network, and involvement with patient's care. The five first subscales were kept in order to build the problem mapping and two categories were added : financial support and daily life problems. Indeed, the last subscale of the FNQ was removed as the goal is here to assess the needs of the patient itself rather than the ones of the family, as relatives are naturally less involved in patient care for concussion than they are for severe brain injuries where they often need to take the medical decision on behalf of the patient. Furthermore, in order to get to the bottom of the problems and dig deeper towards the real motivations of the concussion patients, an intensive use of the "why" has been made during the interviews.

Once the semi-structured interviews have been conducted, it is important to target the areas where there are problems, and to start thinking about solutions in order to build a value proposition.

### **3.1.2 Value map**

The value (proposition) map describes the features of a specific value proposition in a more structured and detailed way than in the business model canvas. It breaks the value proposition down into products and services, pain relievers, and gain creators. The products and services component consists in a list of all the products and services

the value proposition is built around. The pain relievers component describes how the products and services alleviate customer pains. Finally, the gain creators component describes how the products and services create customer gains.

The products and services simply outline the bundle of products and services to help customers get a functional, social or emotional job done, and to address their pains and gains. It is thus an enumeration of all the products and services the value proposition builds on. It is essential to acknowledge that not all products and services have the same relevance to the customers. The products and services can be classified based on the relevance, from the ones that are essential to the value proposition to the ones that are merely "nice to have".

The pain relievers make explicit how the products and services alleviate specific customer pains before, while, and after trying to get a job done. They show which of all the customer pains the value proposition is addressing by eliminating or reducing them. A pain reliever can be more or less valuable to the customer. Therefore, pain relievers can be classified from the essential ones to the ones that are "nice to have". The former relieve extreme issues, often in a radical way, and create a lot of value. The latter merely relieve moderate pains.

The gain creators make explicit how the products and services create customer gains. They show which of all the customer gains your value proposition is addressing by creating benefits and outcomes the customer expects, desires, or would be surprised by, including functional utility, social gains, positive emotions, and costs savings. In the same way as pain relievers, a gain creator can produce more or less relevant outcomes and benefits for the customer and can be classified from essential to "nice to have".

### **3.1.2.1 Mapping the value proposition**

In order to build the value proposition, the first concern is to select the customers' pains and gains. Indeed, the aim is not to address all customers' pains and gains, but to focus on those that will make a difference for them. From there, we need to formulate the key problems for which we want to find solutions.

In order to find ideas to address the identified problems, the approach relies on creativity techniques, such as creative problem-solving (CPS) which is the mental process of searching for an original and previously unknown solution to a problem. The creative problem-solving process was originally developed by Alex Osborn who described in his books *How To Think Up* (Osborn, 1942) and then in *Applied Imagination* (Osborn, 1953) the brainstorming that led to creative problem-solving.

Brainstorming is defined as one of the many methods of ideation, the process of coming up with new ideas (IDEOU, 2020). Brainstorming thus helps generate a large number of innovative ideas and occurs during the divergent phase of the creative process. It involves using a group setting to harness creative thinking by embracing all thoughts, listening to others' ideas, and combining them to come up with the best options. The four rules laid down by Osborn for successful brainstorming are:

- no criticism of ideas;
- go for large quantities of ideas;
- build on each others ideas;
- encourage wild and exaggerated ideas.

Indeed, Osborn believes that quantity produces quality, and that eliminating the notion of judging any idea presented stokes creativity and gives people freedom and flexibility to think creatively and share their thought. This latter belief is also shared by Tom Kelley (T. Kelley, 2001) and his brother, David Kelley, founder of IDEO, a global design and innovation company, and creator of Stanford University's Hasso Plattner Institute of Design, known as the d.school (T. Kelley & Kelley, 2013). Indeed, David Kelley talks in his TedX talk entitled "How to build your creative confidence" (D. Kelley, 2012) about the fear of judgment and how it kills the creativity. Moreover, Osborn believes that brainstorming should address a specific question because, according to him, sessions addressing multiple questions are inefficient. Furthermore, a way to improve brainstorming session is to facilitate the session, *i.e.* having a skilled discussion leader that leads and coordinates the brainstorming session. This facilitator can motivate members, correct mistakes, and provide a clear standard of work.

In the age of Covid-19, working together in the same room is not recommended. Therefore, the co-creation workshop based on the brainstorming principle aiming at generating ideas to solve concussion patients' problems took place online. Indeed, even in a remote environment there are fortunately several tools that can help to solve important problems effectively. MURAL (<https://www.mural.co>) is one of these online collaboration tools. It is an interactive website with a digital dry-erase board that all members can contribute to and it offers a wide range of templates to meet a variety of workshop goals. In addition to this collaborative board, Zoom (<https://zoom.us>), a platform for video conferencing, allowed us to communicate verbally. Four people participated in the one-hour workshop:

- Frédéric Ooms, the facilitator;
- Aurore Thibaut, physiotherapist;
- Nicolas Lejeune, neurologist;
- Myself.

One person was an expert in brainstorming, while it was a first experience for the other three. Besides, two of the participants were concussion specialists. The online co-creation workshop was conducted in three phases. The first one was to define the problem statement. The second one was the divergent phase of brainstorming. And the third and final phase was the convergent phase of voting on our favorite ideas and prioritizing them.

### 3.1.3 Fit

Fit is achieved when the value map meets the customer profile, *i.e.* when the products and services produce pain relievers and gain creators that match one or more of the jobs, pains, and gains that are important to the customer. Fit between what a company offers and what customers want is the number one requirement of a successful value proposition. Fit happens in three stages. The first occurs when the value proposition addresses relevant customer jobs, pains, and gains. The second occurs when customers positively react to the value proposition and it gets traction in the market. The start-up movement calls these problem-solution fit and product-market fit, respectively. The third occurs when a scalable and profitable business model is found.

In conclusion, the aim of the interviews with concussion patients is to build the customer profile of the value proposition map, and eventually have a first insight of the value map with possible solutions. The co-creation workshop, that gathers both specialists of concussion and creativity techniques in addition to me, aims, based on the customer profile, to build the value map that achieve a fit.





# Chapter 4

## Results and analyses

This chapter presents the results of this work. First, the results and analyses of the interviews carried out with the concussion patients are given, and the customer profile is built. Secondly, the results of the co-creation workshop are presented, and the value map is established. Finally, the fit between the customer profile and the value map is verified.

### 4.1 Results of the interviews: building the customer profile

Seventeen concussion patients were interviewed. Socio-demographic and other characteristics of the sample are presented in Figure 4.1. The sample is composed of 65% of women. The mean age of the interviewees is  $27 \pm 8$  years (range: 18 to 44 years). Only 4 over the 17 interviewees were working at the time the concussion occurred, the others were at school. The mean time since the concussion is  $5 \pm 4$  years (range: 8 months to 12 years). Among the sample, 47% of the concussions occurred while playing sport. However, a wide variety of sports were observed: horse riding, basketball, football, judo, mountain biking, and circus. 35% of the concussions are the result of a fall, 12% of a car accident, and the last 12% are due to violence. Concerning the recovery of the concussion, 23% of the interviewees reported that all the symptoms disappeared within a few days, while 12% had to wait several years, and finally, a majority of them, the remaining 65%, still presents persistent post-concussion symptoms. The most common

post-concussion symptoms are headache, tiredness, memory and concentration impairments, photophobia, and sensitivity to noise.

The results of the interviews with the concussion patients are summarized in Figure 4.2 and Figure 4.3, which are respectively the customer profile and the ranking of jobs, pains and gains. These jobs, pains, and gains identified by the concussion patients are described in more detail in the following sections.

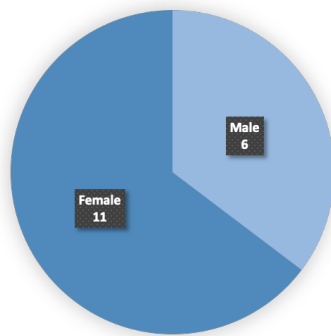
### 4.1.1 Jobs

As a result of the interviews, the following jobs were identified.

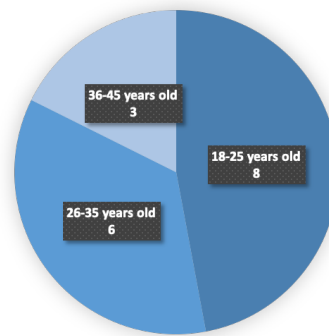
**Accept it is a genuine handicap even if invisible** According to concussion patients, this is the most important job they want to achieve. Indeed, even if they have any visible sign as it is the case with a broken arm or leg, it does not make it any less painful. However, the fact that it is invisible makes it harder for them to accept their problem. They are mistakenly tempted to think that everything is fine and that it is not serious. Concussion patients reported the importance to accept that they have a concussion with all the consequences that come with it, accept that this can be a real disability, and accept it is necessary to rest. They also need to accept that they might no longer be able to go to school or to work, sometimes for several months, or accept that some things are harder to do or take more time, for example.

**Carry on with life** Another very important job after accepting the concussion and its consequences, according to the interviewees, is to carry on with their life. Indeed, many patients are unable to return to school or work for a few days after the concussion, sometimes for several months, if ever. Therefore, it becomes an important will for them to eventually go back to school, to take their exams, to graduate, or to go back to work, for example.

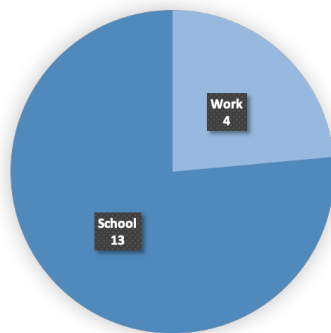
**Live with concussion and adapt** Beyond the fact that the patients want to get on with their lives, they also need to learn how to live day-to-day with the post-concussion symptoms. There are many things they are not able to do in the same way as before



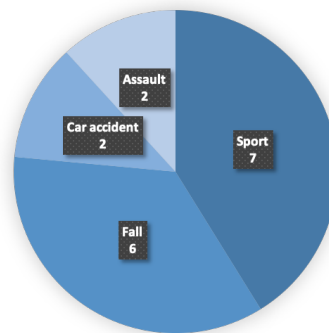
(a) Gender



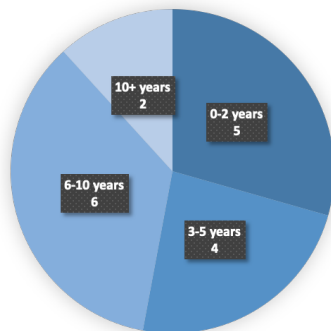
(b) Age



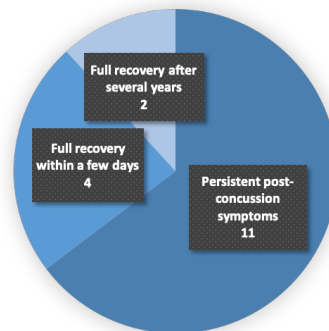
(c) Working status



(d) Circumstances of the concussion



(e) Time since the concussion



(f) Recovery of the concussion

Figure 4.1: Characteristics of the sample of interviewees.



Figure 4.2: The customer profile of the concussion patient, giving their jobs, pains, and gains.

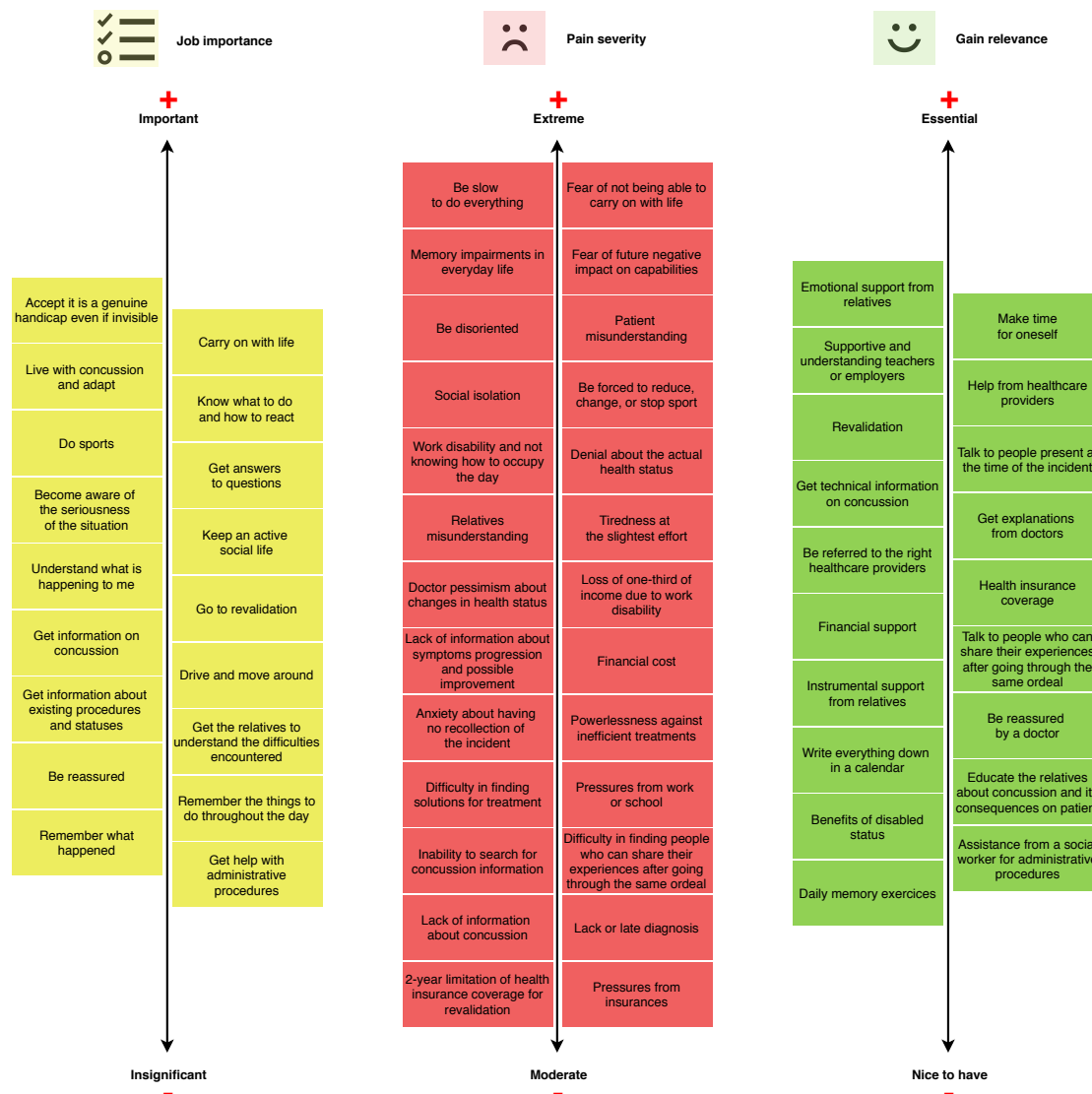


Figure 4.3: The ranking of the jobs, pains, and gains of the concussion patient.

and they therefore need to adapt. As an example, an interviewee stated that raising her children was more difficult than before because she was much more sensitive to noise, among other things. Due to memory impairments, some patients can have difficulty remembering if they have already eaten during the day, or remembering where a room is located in their own house. And there are many other examples of problems they need to tackle in their daily lives as a result of the concussion.

**Know what to do and how to react** Patients reported that another important job for them is to know what to do and how to react because they sometimes feel powerless after the concussion. Moreover, some patients bemoan the fact that they were not advised on what to do and what not to do such as avoiding screens, staying in the dark, or resting.

**Do sports** Many patients, especially the younger ones, feel the need to do sports while it is not recommended in the days following the concussion and as long as symptoms persist. Therefore, patients with persistent post-concussion symptoms can often no longer play sport as they used to.

**Get answers to questions** The need for answers is another frequently encountered need expressed by patients. They mainly desire to have a specialist that answers all their questions. Indeed, they often want to know how their health status is going to evolve, what are going to be the consequences of the concussion on the short and long terms, and so on.

**Become aware of the seriousness of the situation** Patients often take it lightly and refuse to rest, for example, or return to school or work way too early before they realize how serious the situation is. Therefore, it is a need to be aware of the seriousness of the situation from the outset so as not to aggravate the symptoms and slow down the recovery.

**Keep an active social life** The social life is an important aspect for concussion patients. They want to keep an active social life despite the fact that they are unable to go to the cinema or the restaurant with friends, go to concerts or go to any noisy place, for example.

**Understand what is happening to me** Patients usually have difficulty understanding what is happening to them. Concussions are not always diagnosed directly. And when they are, they do not always understand why they have certain symptoms.

**Go to revalidation** For the patients with lasting symptoms that affect their lives, revalidation is a necessity. However, it is sometimes an ordeal in itself to drive to the hospital, to find a parking space, and so on. And sometimes they are exhausted just by doing so.

**Get information on concussion** Patients simply want general information on concussion, such as answers to the following questions: What is a concussion ? Why does it happen ? What are the consequences ? What are the risks ? What can be done to heal ?

**Drive and move around** After the concussion, patients want to drive their car and be able to move around as they used to. They are willing to move but are sometimes unable to walk because of the lack of balance, for example, or they want to drive their car but they cannot remember their way and feel desoriented.

**Get information about existing procedures and statuses** Another need expressed by concussion patients is to know what procedures and statuses exist and for which they are eligible. Some interviewees highlighted the fact that they had the opportunity of staggering their academic year at the university due to disability status obtained after the concussion for example, while others confessed that they learned about the possible procedures too late. For patients who are in active life and unable to work, there are procedures for obtaining replacement income.

**Get the relatives to understand the difficulties encountered** An important job for concussion patients is to get their relatives to understand what they are going through and the difficulties they are facing. Indeed, due the fact that their problems are somehow invisible since they are mainly happening in their head, the relatives have difficulties understanding. Therefore, patients have to spend their time explaining, sometimes even justifying, why they are unable to do certain things. Again, with a broken leg, it is not difficult to understand why a person cannot walk, but, after a concussion, it is a whole different matter.



**Be reassured** Another thing patients need is reassurance about the future, about being able to return to a normal life, about the things they will be able to do going forward. Indeed, they often fear the unknown that surrounds their future, and the possibility that it may be disrupted by the after-effects of the concussion. Moreover, patients also need to be reassured about the present because they sometimes wonder whether it is normal what they are currently going through, whether the symptoms they are experiencing are not unusual, and so on.

**Remember the things to do throughout the day** As a consequence of the concussion, many patients experience some memory impairments, which can be annoying in the daily life. Therefore, remember the things they have to do throughout the day is a real job according to them. They want to remember the appointments, remember that they need to go shopping and when they do, remember the shopping list. As some patient may have difficulty to remember if they have already eaten their meal in the day, they also need to know when they have to eat.

**Remember what happened** Many patients present an amnesia after the concussion and are unable to recall the circumstances of the injury. They may not even be able to remember what happened a few hours before and/or after. Therefore, they feel the need to fill in everything they do not remember.

**Get help with administrative procedures** The patients that have the most severe symptoms are also the ones with the most procedures to undertake, and, considering their health status, this is often a laborious task. Therefore, these patients need help with the administrative procedures.

### 4.1.2 Pains

As a result of the interviews, the following pains were identified.

**Be slow to do everything** According to the interviewees, the most extreme pain in terms of severity is to be slow to do everything which can be really annoying and frustrating.

**Fear of not being able to carry on with life** The second most severe pain is the fear of not being able to finish school and be graduated for the young patients and the fear of not being able to go back to work for those of working age.

**Memory impairments in everyday life** The following pain according to concussion patients results from memory impairments which can be really disabling in day-to-day life, and very difficult to overcome. Indeed, these memory impairments can be quite annoying such as not remembering where the bathroom is, forgetting the names of your friends, not knowing if you have already eaten during the day, and so on.

**Fear of future negative impact on capabilities** Almost all concussion patients are afraid they will never get their abilities back, and thus somehow fear the future. They, for example, fear of not being able to recover the memory or not being able to concentrate in the future. Some even get anxiety attack when they realize that they are no longer able to do much, and they rapidly get worried about what they would be able to do in the future. A patient even confided that he was afraid to look for information because of the fear of finding unwanted after-effects.

**Be disoriented** Another severe pain for patients is being disoriented, not knowing what to do and how to react, and having the feeling to be somehow powerless.

**Patient misunderstanding** Beyond being disoriented, patients do not always fully understand what is going on with them, their body, and in their head. They are not always aware of the problems they have, which leads to an unpleasant feeling. They even feel angry sometimes.

**Social isolation** Many patients reported that the social isolation imposed by the concussion is really painful. Indeed, in the days directly following the concussion, patients are often advised to rest at home. As the days go by, some of the patients are able to resume a social life, while others suffer from persistent post-concussion symptoms preventing them from any sort of social activity. Photophobia, sensitivity to noise, headache, or concentration impairment are some of the reasons why patients avoid going to the cinema or to the restaurant as an example. Even at home, with their family

or partner, watching a three-hour movie without headache or without losing track of the story became impossible for some of them. Similarly, following the conversations of friends in restaurants became a real challenge. Patients regret being forced to give up almost all friendly, loving and professional relationships.

**Be forced to reduce/change/stop sport** Especially among the young interviewees who experience persistent post-concussion symptoms, be forced to stop playing sports as they usually do is really difficult to accept.

**Work disability and not knowing how to occupy the day** When patients are not able to go back to school or to work for a long period of time, they usually feel useless and bored.

**Denial about the actual health status** Many patients diagnosed with a concussion tend to trivialize it. They often think that they just have a headache and refuse to rest for that. However, these headaches eventually get worse, and the recovery slows down. Patients really have a hard time accepting they have a real problem.

**Relatives misunderstanding** The fact that the family, partner, or friends of the concussion patients do not understand the problems they are facing make them feel like they constantly need to explain themselves, justify themselves. Therefore, they sometimes feel guilty, but mostly annoyed and angry. The relatives tend to think that, since they see no visible injury, the patients have nothing, and should therefore be able to be like before, as if nothing happened, which of course is often not possible. This is thus sometimes the cause of arguments.

**Tiredness at the slightest effort** Another thing that annoys some concussion patients is the fact that they get tired every time they do something, which forces them to rest much more than they did before the injury. Moreover, it makes them feel that they are not able to do everything as before because of this.

**Doctor pessimism about changes in health status** While most patients sincerely want to know how their health status will evolve, doctor pessimism is discouraging,

even depressing. It is hard for patients to hear, for example, that they might only recover 50% of their brain, 80% if they are lucky. This inevitably induces a fear of the future, of what they would be able to do in the future.

**Loss of one-third of income due to work disability** The financial loss due to the reduced income as a result of the inability to work is undeniably an undesirable consequence of concussion for patients who were working before the injury.

**Lack of information about symptoms progression and possible improvement** Although patients do not like receiving bad news about how their condition might evolve, the lack of information about symptoms progression and possible improvement is just as undesirable. Therefore, when doctors simply cannot predict how and when patients are going to recover, patients are in a state of unpleasant uncertainty.

**Financial cost** Younger patients who are still financially dependent on their parents do not necessarily feel this burden. But according to the others, these costs are unwelcome. Even if the health insurance refunds most of the costs induced by the concussion in drugs, medical care, rehabilitation, and so on. They are not totally covered, and of course, they still are indirect costs which are entirely at the patients' expense such as the cost of travelling to medical consultations, as an example.

**Anxiety about having no recollection of the incident** The amnesia caused by the concussion makes patients anxious. They are scared of not being able to recall the circumstances of the concussion, and sometimes even a few hours before or after.

**Powerlessness against inefficient treatments** Patients feel sometimes powerless against the inefficiency of treatments. Therefore, they endure the pain caused by the various symptoms without being able to do anything about it.

**Difficulty in finding solutions for treatment** Patients may feel powerless against ineffective treatments, it is nonetheless not for lack of trying. Indeed, some patients claimed they have tried literally everything, from grandmother's remedies to medical

treatments recommended by a range of specialists, before eventually finding the solution, if ever. Therefore, some patients regret not being advised enough on the right treatments, or simply the right persons.

**Pressures from work or school** This is fortunately not something that each patient has to endure, but it happens sometimes that work or school exerts a certain pressure by doubting that patients are having serious difficulties that keep them from going to work or to school, or, when they do, doubting they are not able to study or work as they used to. Patients are sometimes accused of exaggerating or being lazy, for example.

**Inability to search for concussion information** Concussion patients reported some frustration and even anxiety caused by the inability to seek information on concussions while they really want to have some. Indeed, directly after the injury, they can often not perform an online search as the use of screens is prohibited.

**Difficulty in finding people who can share their experiences after going through the same ordeal** When you do not have a relative or you do not know anybody that has been through the same ordeal, it is really difficult to get in touch with someone who can share their experiences, give you advice, or reassure you.

**Lack of information about concussion** Simply the lack of information about concussion is, according to patients, a pain. Indeed, many are diagnosed in a hospital emergency room, but do not receive the necessary information and return home totally confused and disoriented.

**Lack or late diagnosis** Some patients reported that the concussion was not directly diagnosed at the first visit to the emergency room. Indeed, when patients present multiple traumas, it is common to perform examinations to check for a wrist fracture, for example, but forget to investigate the head. Patients state that symptoms of the concussion were, according to them, not taken seriously.

**2-year limitation of health insurance coverage for revalidation** Some patients regret not being able to continue the rehabilitation after two years while they still feel like

they need it.

**Pressures from insurances** The pressure exerted by insurances on patients is a severe pain for those who experience it. Indeed, some patients have to stand up to occupational physicians that do not understand that post-concussion symptoms can prevent them from working.

### 4.1.3 Gains

As a result of the interviews, the following gains were identified.

**Emotional support from relatives** The most essential gain according to concussion patients is to be well surrounded and to simply have someone, family, parents, partner, or friends, to talk to about what they are going through.

**Make time for oneself** Patients reported it is really important to take some time for themselves in order to be able to decompress, get some rest, and so on. For example, setting up a system to rest during the day is really beneficial for some of them.

**Supportive and understanding teachers or employers** In contrast to the pressures sometimes exerted by school or work, which can be a severe pain for patients, having supportive and understanding teachers or employers is an essential gain and really helps many patients to gradually return to work or school, and thus get on with their life. Patients reported that teachers, on the one hand, took their difficulties into consideration, adapted the schedule of their exams, and agreed to delay them. They also accepted certain accommodations such as a mid-course break. On the other hand, supportive employers agreed with a part-time return to work, or were flexible with regard to working hours.

**Help from healthcare providers** There are many healthcare providers, such as neurologist, physiotherapist, ergotherapist, psychologist, or neuropsychologist, who are able to help concussion patients get better. Indeed, one patient reported that she had

frequent and very painful headaches, and that, after trying many things, she was advised to go to a physiotherapist who specializes in headaches. It really made her feel better. Some patients also fall back on acupuncture, for example. However, beyond the medical assistance provided by these healthcare providers, they are also very helpful to patients by giving explanations, answering questions, referring to other specialists they know, or providing information about administrative procedures. Indeed, some patients complain that they have no other means of obtaining this kind of information, and are therefor grateful to their healthcare providers for being there for this purpose as well.

**Revalidation** Revalidation is of course of many help to patients with post-concussion symptoms to apprehend their life after the concussion and recover. Indeed, the neurocognitive rehabilitation uses cognitive tasks to improve cognitive processes, or it may involve developing compensatory strategies to address difficulties with aspects of cognition, such as attention, memory, and executive functioning.

**Talk to people present at the time of the incident** Patients who are anxious of having no recollection of the circumstances of the concussion and sometimes few hours before and/or after are really reassured to talk to people present at the time of the incident who are able to fill in gaps in memory.

**Get technical information on concussion** Another gain according to patients is to get technical information in order to understand what is really going on with their body. Indeed, it somehow comforts them and makes them less anxious.

**Get explanations from doctors** In the same way, getting global explanations from doctors reassures the patients. Doctors can give them information about the concussion and what to do to treat it and reduce symptoms. They can also explains them how symptoms may evolve.

**Be referred to the right healthcare providers** By contrast to the pain expressed by patients of having difficulty finding solutions for treatments, it is a real gain when they are referred to the right healthcare providers. Indeed, patients do not always know who to turn to, they are not always aware that they are specialist that can help them.

Therefore, having the doctor or another person that refer them to the right specialist according to the problems they suffer helps them a lot and saves them a lengthy and sometimes unsuccessful search.

**Health insurance coverage** The health insurance coverage is a financial gain for patients and helps them pay for the medical care they need such as drugs, medical consultations, and so on.

**Financial support** Beyond the medical expenses, patients often need a financial support, especially when they are adults and financially independent. Sometimes, patients are unable to go back to work for several months. In extreme cases, it happens that patients never return to their work. Therefore, it is essential for them to have a replacement income.

**Talk to people who can share their experiences after going through the same ordeal**

Talking with someone who has been through the same ordeal is often a real gain for concussion patients. This person may be a relative, a friend or a complete stranger who has experienced a concussion once in their life. The benefits are many. When people share their experience with the patients, it can reassure them about the future. They can simply be advised on how to react, which specialist to consult, get advice on what can help them reduce symptoms, and therefore return to normal life more quickly, for example.

**Instrumental support from relatives** In addition to emotional support, relatives can also provide an instrumental support to patients. When patients are scared or not able to live on their own for a while, relatives can take them in. They can also drive them everywhere they need to go, to medical consultation, for example. They can also help them to do everything they daily need to do.

**Be reassured by a doctor** A doctor which tell patients that it is normal to have symptoms such as amnesia, and not to remember the few hours before and/or after the incident, or other kind of symptoms really reassures them. Another thing that reassures them is to be told that they will recover gradually. Comforting words coming from a



doctor have all the more impact since they come from someone who knows what he or she is talking about and can thus be trusted.

**Write everything down in a calendar** When patients have to live day after day with memory impairments, writing everything down helps them remembering appointments, grocery lists, or if they have already took their meal, for example.

**Educate the relatives about concussion and its consequences on patient** Too rarely realized, informing families or friends about the concussion so that they are aware of the difficulties and are able to understand what the patient is going through is beneficial for them.

**Benefits of disabled status** When patients suffer from post-concussion symptoms that prevent them from returning to school or work, disabled status can help them get some advantages such as be allowed to stagger their academic year at university, or help them get financial aids.

**Assistance from a social worker for administrative procedures** Patients who need to submit applications for replacement income, for example, are patients with fairly severe post-concussion symptoms, and their condition makes it difficult to complete administrative procedures on their own. Therefore, the assistance of a social worker is welcome.

**Daily memory exercises** Doing online memory exercises allows to some patients to see improvement and get better.

## **4.2 Results of the co-creation workshop: building the value map**

The workshop consisted of three main steps: the definition of the problem statement, the brainstorming, and the prioritization of ideas. After all workshop participants had briefly introduced themselves, we began the first step.

### 4.2.1 Definition of the problem statement

I started by explaining in a few words to the other participants the main results of the interviews conducted with the concussion patients. I therefore presented them the most important jobs, the most severe pains and the most relevant gains of the customer profile corresponding to concussion patients. Based on these results, we agreed on the following problem statement: "How might we inform patients and those around them about the consequences of concussions?". Indeed, it appeared that better informing patients about the consequences of concussions matched several jobs, could relieve several pains and create several gains. Obviously, the customer profile raised many various brainstorming subjects, but we had to choose one since the aim of a value proposition is not to address all customers' pains and gains, and since a specific question must be addressed for a brainstorming session to be effective.

### 4.2.2 Brainstorming

The second step consisted in the brainstorming, *i.e* generating a large number of ideas addressing the problem statement through creative thinking. We were thus invited by the facilitator to write down on sticky-notes in the collaborative board on MURAL as many ideas as possible to cope with the problematic we chose: first, freely; then, with the help of a google search for inspiration. In the latter case, we associated the ideas written on sticky-notes to an URL link. All the ideas we came up with are given in Figure 4.4. In this figure, the orange sticky-notes correspond to the ideas associated with an URL link. These latter ones are all referenced below:

- Inform and do prevention in schools (Laly Foundation, n.d.)
- Organize social sharing events outside the medical context (Association du diabète, n.d.)
- Make a short and very didactic video (The Ottawa Hospital, 2016)
- Organize support groups/newspaper/awareness-raising of authorities (Le Noyau aslb, n.d.)
- Make recommendations for professionals (KCE (Centre Fédéral d'Expertise des Soins de Santé), 2016)
- Provide a FAQ such as the one on Post-Traumatic Stress Disorder (Brunet, 2009)

How might we	inform	patients	and those around them	about the consequences	of concussions?
Set up a hotline	Teach in schools	Organize a follow-up from emergency room to reintegration <span>2</span>	Inform and do prevention in schools	Create a certified training for caregivers <span>1</span>	Organize social sharing events outside the medical context <span>1</span>
Create a WhatsApp group	Make a short and very didactic video <span>2</span>	Write a guidebook/manual	Organize support groups for families <span>1</span>	Census all specialists by region <span>1</span>	Make legal recommendations
Raise awareness in workplaces <span>1</span>	Impose sanctions if concussion is not reported by school, sport, etc.	Conduct all-audience information/awareness conferences <span>1</span>	Organize support groups/newspaper/awareness-raising of authorities	Make an advertising/awareness campaign	Create a Facebook/Instagram page <span>1</span>
Make recommendations for professionals	Create a platform for sharing <span>1</span>	Provide a FAQ such as the one on Post-Traumatic Stress Disorder <span>1</span>	Make a movie	Propose a MOOC	Organize support groups for patients <span>1</span>
Provide information on the pathology + concrete information in everyday life <span>1</span>	Do prevention in schools and sport	Conduct multidisciplinary consultations	Create a website <span>1</span>	Conduct training courses and inform sports coaches <span>1</span>	Inform the patient/training/ videos/ prevention & treatment/ testimonials
Create a Youtube Channel <span>1</span>	Organize conferences	Train home support workers <span>1</span>	Advise on the resumption of sports and intellectual activities	Create videos for relatives <span>1</span>	Carry out a step-by-step management of post-traumatic stress syndrome until reintegration into the labour market

Figure 4.4: Results of the brainstorming gathering the ideas addressing the problem statement. The blue sticky-notes give the problem statement. The yellow ones are the ideas freely written. The orange ones are those inspired from a google search and associated to an URL link. The pink dot in the right upper corner of the sticky-notes indicates a crush idea with the number of votes.

- Provide information on the pathology + concrete information in everyday life (Aide aux jeunes diabétiques, n.d.)
- Inform the patient/training/videos/prevention & treatment/testimonials (France AVC, n.d.)
- Organize conferences (Fondation Arthrose, n.d.)
- Advise on the resumption of sports and intellectual activities (Institut national d'excellence en santé et en service sociaux (INESSS), n.d.)
- Carry out a step-by-step management of post-traumatic stress syndrome until reintegration into the labour market (Homewood Health, n.d.)

### 4.2.3 Prioritization of ideas

After the divergent thinking phase allowing to create choices, we switched to the convergent thinking phase to make choices. In this last step of the co-creation workshop, we voted for our crush ideas. Each participants had 5 votes to be attributed to the different sticky-notes, with the possibility to vote several times for the same idea. The distribution of votes can be seen in Figure 4.4 with the pink dots in the right upper corner of the corresponding sticky-notes. Finally, the crush ideas, corresponding to the sticky-notes with vote, were ranked in terms of their importance and feasibility, and placed accordingly on the graph, as it can be seen in Figure 4.5. This last step closed the workshop.

### 4.2.4 Building the value map

Using the results of the co-creation workshop, it is possible to build a value proposition with the value map of the value proposition canvas, by selecting a few ideas from Figure 4.5 to compose our solution. Nine of the ideas from varying importance and feasibility have been chosen to establish a value proposition for concussion patients. The proposed value map is illustrated in Figure 4.6.

The proposed solution is based on the development of a website, or possibly a progressive web app in order to ease the use on smartphones and make it more friendly. The first purpose of the website would be to inform people about concussions by providing definitions, information about outcome, risk factors, recovery, symptoms, and

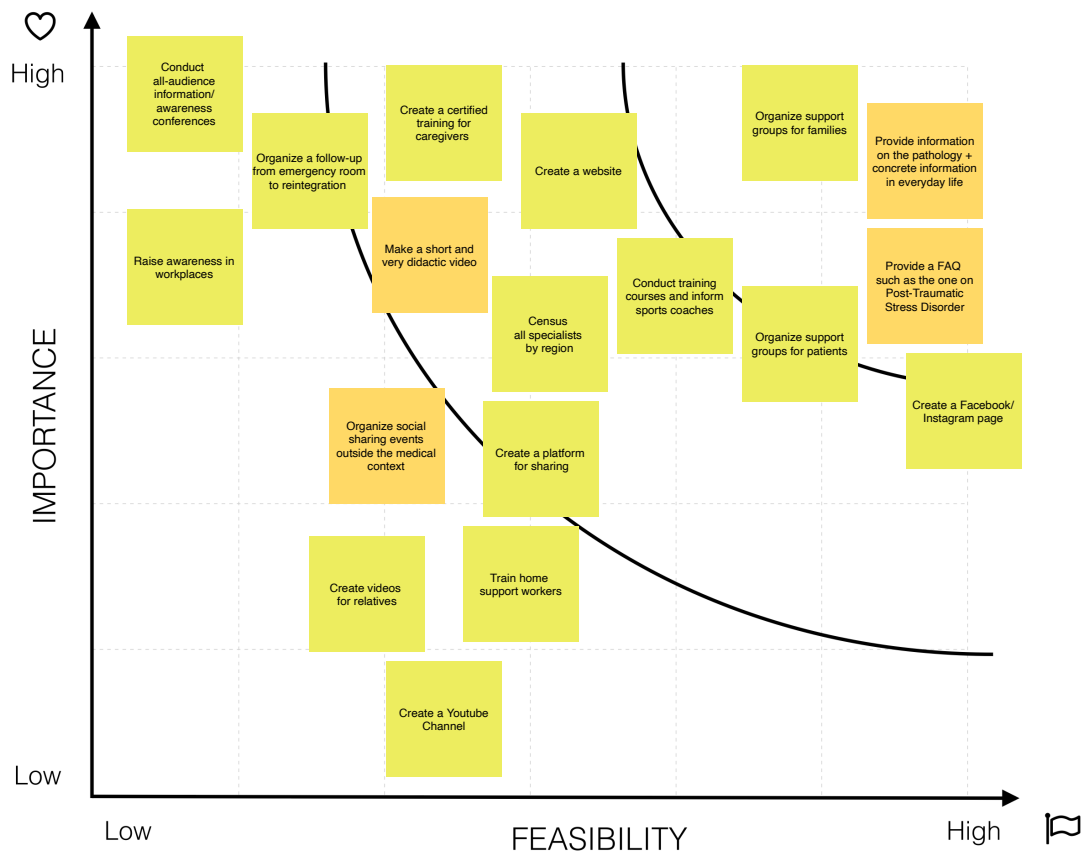


Figure 4.5: Prioritization of the crush ideas based on importance and feasibility.

treatments. The website would also provide useful tips and tricks to live with the consequences of a concussion on a daily basis. It could also give useful information about sport, school, work, social aid, or insurance. A short and didactic video presenting the concussion would find its place on the home page of the website, but could also be shared widely on social networks in order to inform as many people as possible so that they can recognize the sign of a concussion when needed. A very didactic video is also an easy tool to inform children. Another thing the website would provide is a list of specialists by region, so that patients can easily find the professional help they need, and be fully aware of all the possibilities that exist to relieve and help them when they are suffering from severe post-concussion symptoms. The website should also be composed of a FAQ page, which is an organized collection of valuable information for concussion patients. Indeed, a FAQ is known to improve customer's experience on website (Strategy Beam, 2017) on the one hand and increase online visibility on Google and other search engines on the other hand. One of the strongest reasons to have a FAQ section is to address the needs of the readers. Moreover, the use of a FAQ section is a way to establish the website as a trusted expert. Furthermore, the website could be associated with a Facebook page and an Instagram page to widely share information on the one hand, and allow people on the other hand to interact with each others, to react to some publications, and share their experience with others. A Facebook page would also be an easy way to create an active community of concussion patients and inform them of social sharing events that bring concussion patients and their relatives together. These events are a way to create bonds, exchange experiences, but, most of all, to keep some kind of active social life with people who are aware of the difficulties encountered by concussion patients in a proper context with activities adapted to the patients' health status. Finally, by taking advantage of the patient community thus created with the website, Facebook page, and Instagram page, support groups, in person or online, can be organized so that patients and relatives can talk about issues related to their injury, learn new coping strategies and get emotional support.

Going further, a tool that can be added to the website in order to simplify the interaction between the person visiting the website and the website itself is a chatbot. Indeed, a chatbot is an artificial intelligence (AI) software that can simulate a conversation (or a chat) with a user in natural language through messaging applications, web-

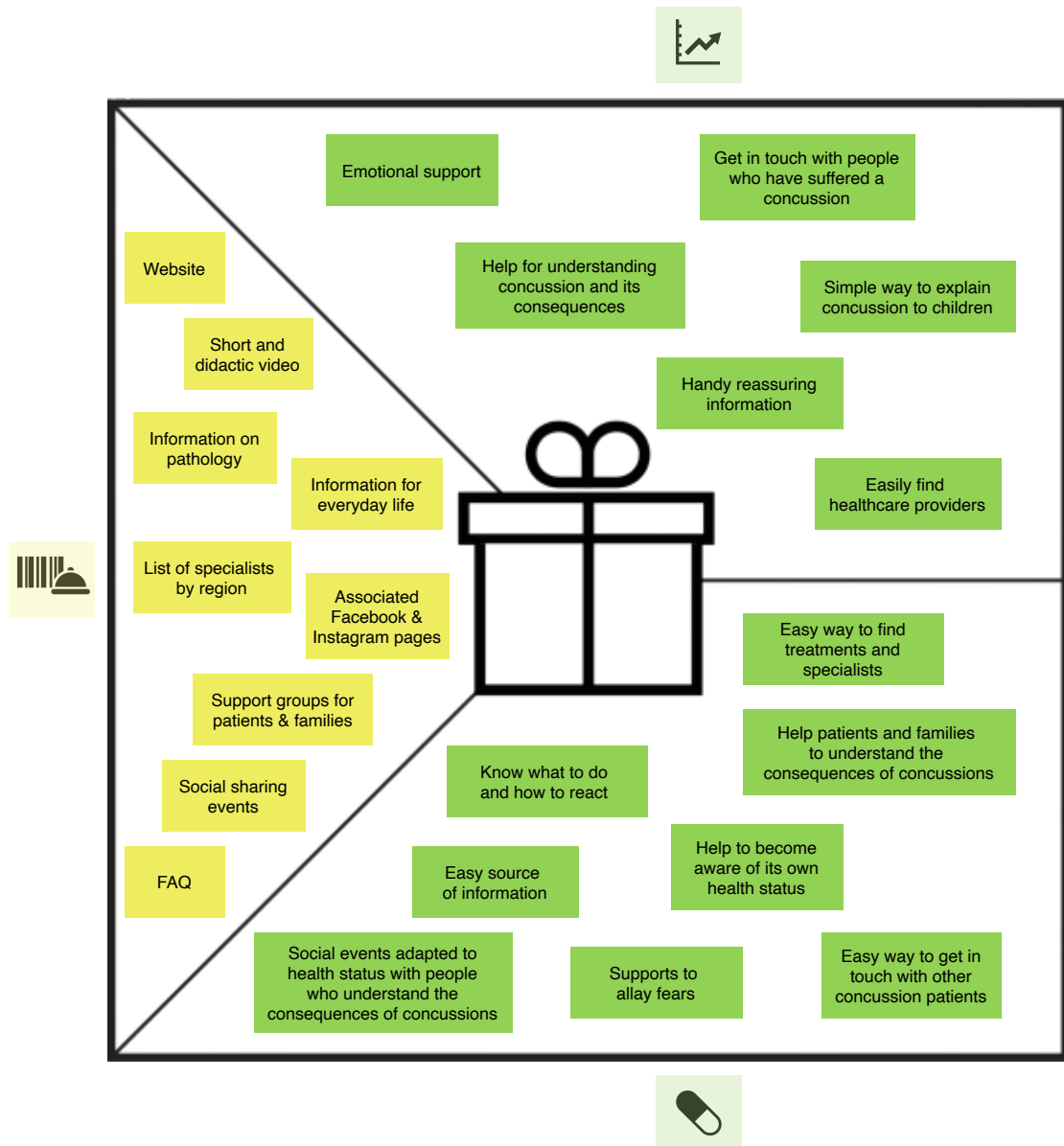


Figure 4.6: The value map for the concussion patient, giving the products and services, the gain creators, and the pain relievers.

sites, mobile apps or through the telephone (Expert system, 2020). Chatbot applications streamline interactions between people and services, enhancing customer experience. Furthermore, with the feedback they collect through simple questions, chatbots provide a deeper understanding of people who visit the website and help to make improvements on the services provided so that the website better meets expectations over the long term. However, the most important asset of chatbots for concussion patients is that they offer instant responses and are available 24/7. This way, a patient visiting the website can find the desired information via the chatbot very quickly and easily, reducing the time spent in front of the screen, which is a non-negligible benefit for a person suffering from severe symptoms. Indeed, by simply asking about a specific symptom, the chatbot can direct the person to the pages that give the definition, the associated treatment, the specialist to consult, and so on.

This value proposition creates several gains for concussion patients such as the availability of information, a help to understand concussion and its consequences, an easy access to healthcare providers, the resources to explain concussion in a very simple way, the possibility to easily get in touch with people who have suffered a concussion, and an emotional support. It also relieves many pains for concussion patients by alleviating fears, making it easier to find information, helping them to know what to do and how to react after a concussion, and helping them realize the seriousness of their condition. The solution also allows them to maintain a certain social life through the organization of social events, and enables them to meet other concussion patients. It helps them in the search for treatments and specialists. Finally, it helps them and their relatives to understand the consequences of concussions.

#### **4.2.5 Checking the problem-solution fit**

We can reasonably say that the value proposition achieves a problem-solution fit. Indeed, let's recall that a fit is achieved when the value map meets the customer profile, or, in other words, when the products and services produce pain relievers and gain creators that match one or more of the jobs, pains, and gains that are important to the customer. Figure 4.7 and Figure 4.8 show which jobs, pains, and gains the value proposition addresses. Check marks in black dots signify that products and services relieve pains or



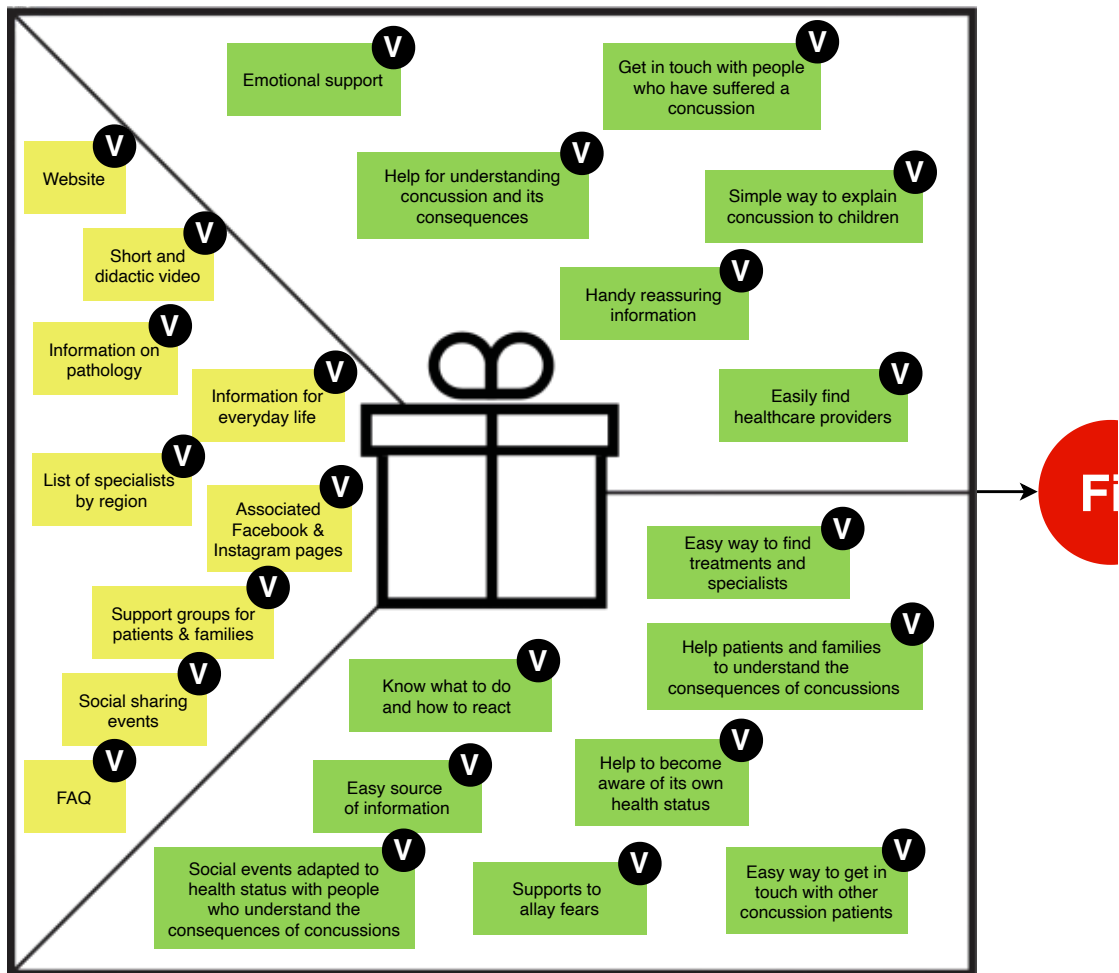


Figure 4.7: Fit between the value map and the customer profile (part 1).

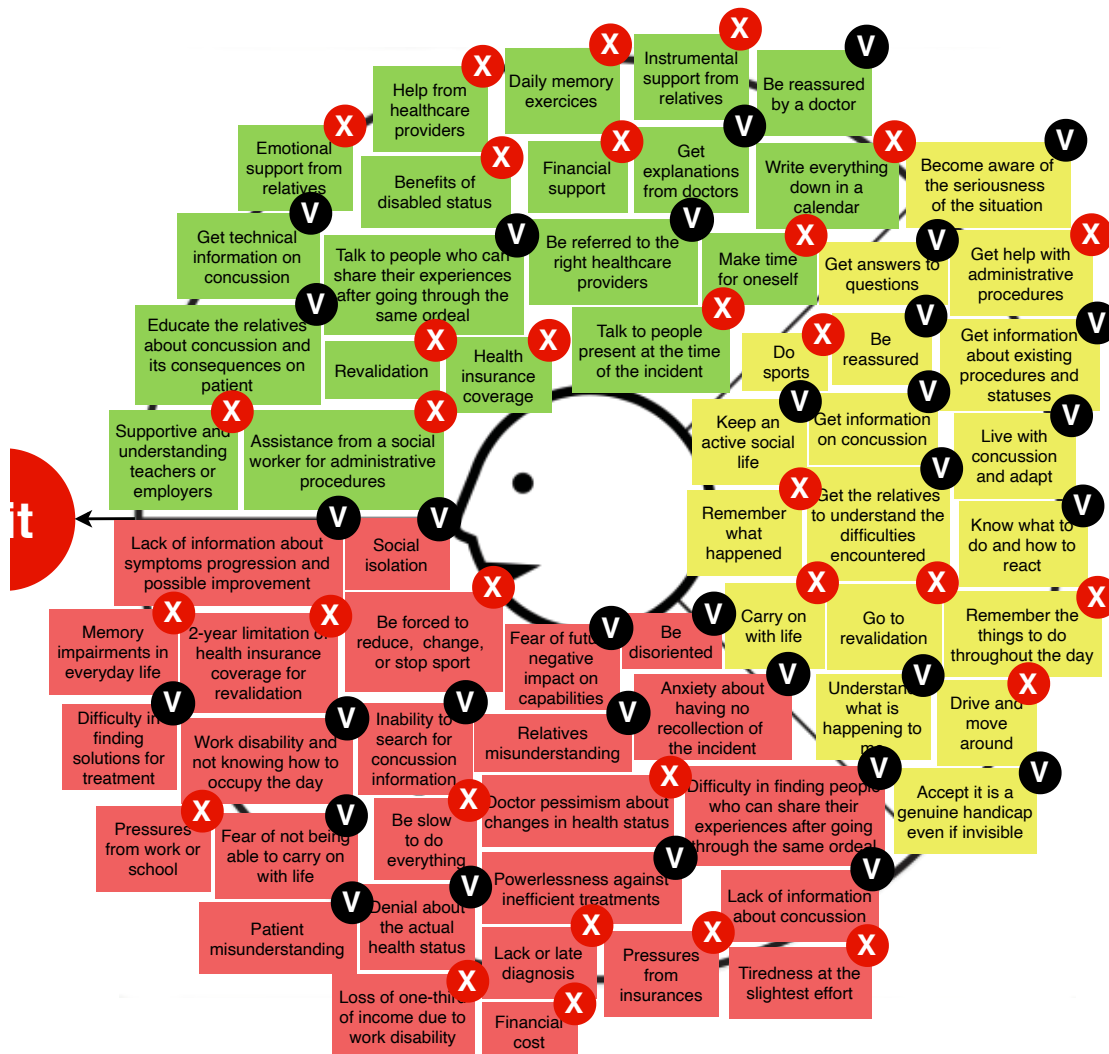


Figure 4.8: Fit between the value map and the customer profile (part 2).

create gains and directly address one of the customers' jobs, pains, or gains. X crosses in red dots show which jobs, pains, and gains the value proposition does not address. The value proposition matches eleven jobs out of eighteen, six gains out of thirteen, and fifteen pains out of twenty six.

# Chapter 5

## Conclusion

This work intends to build a value proposition for concussion patients. To this end, the problems and needs of concussion patients are identified and the customer profile is built based on interviews. Solutions are then sought in a co-creation workshop and the value proposition is mapped.

In more detail, the first step was to clarify the background with a research on concussion in order to be able to step into the customer's shoes along the way. The second step was to gain a deep understanding about the customer with the mean of semi-structured interviews conducted with concussion patients. The third step was to synthesize all insights and to define the key customer's problem to solve, by analyzing all the information gathered from the interviews. This step gave rise to the customer profile. The fourth step was to generate ideas in a co-creation workshop, and then prioritize the ideas based on importance and feasibility. The last step was to map the value proposition in order to achieve a fit with the customer profile.

Results of this work show that patients are often facing their problems on their own. They lack information. They need support. They have far too often no one to talk to about their experience. They have difficulties to find the help they need. Among the pains encountered by concussion patients, we find fear, misunderstanding, disorientation, lack of information, social isolation, or financial cost in addition to their symptoms. Patients benefit from several gains such as emotional, instrumental and financial supports, help from healthcare providers, or help in their professional reintegration,

among others. The value proposition made in this work aims at informing patients and those around them about the consequences of concussion with a solution based on the development of a website that addresses many of their pains and gains.

The continuation of this work would be to verify the product-market fit, *i.e.* verify that customers positively react to the value proposition and that it gets traction in the market. Finally, it would be to find a scalable and profitable business model in order to achieve a complete fit. And of course, this is achieved through an iterative process with prototyping and testing phases. Indeed, the solution needs to be discussed with concussion patients in order to verify that it correctly addresses their problems and to converge on better solutions.

# Appendix A

## Interview guide for concussion patients

- What is your age?
- What is your gender?
- When did the concussion occur?
- In which circumstances did the concussion occur? (At work, playing sport, other?)
- Have you suffered multiple concussions? If so, how many?
- Do you still have symptoms? If not, after how long did they disappear?
- What are or were the main symptoms ?
- Did you have any kind of medical follow-up?
- Did you have a revalidation?
  
- What problems have you experienced as a result of your concussion (from the incident until now)?
  - *Jobs*
    - What problems are you trying to solve?
    - What needs are you trying to meet?
    - What tasks do you need or want to perform?
  - *Pains*
    - What is bothering you?
    - What prevents you from carrying out these tasks?
    - What are the risks?
    - What are you afraid of?

- *Gains*
  - What makes you happy?
  - What helps you with these tasks?

# Appendix B

## Problem mapping

- **Health information**

- Explanations from professionals about concussion
- Information on possible symptoms and treatments
- ...

- **Emotional support**

- Understanding of relatives on how difficult it is
- Help getting over doubts and fears about the future
- ...

- **Instrumental support**

- Help from relatives
- ...

- **Professional support**

- Rehabilitation programs
- Physical therapy
- ...

- **Financial support**

- Insurance coverage for treatments and therapies



- Replacement income
  - ...
- **Community support network**
  - Understanding of employer, coworkers, or teachers regarding the problems of the patient
  - Discuss with someone who has gone through the same experience
  - ...
- **Daily life problems**
  - Social life
  - Daily tasks (cooking, cleaning, etc.)
  - ...

# References

- Agence pour une Vie de Qualité (AVIQ). (2020). Le traumatisme crânien. Retrieved June 26, 2020, from [https://www.aviq.be/handicap/pdf/documentation/publications/informations\\_particulieres/fiches\\_deficiences\\_emploi/Fiche05-Traumatismecranien.pdf](https://www.aviq.be/handicap/pdf/documentation/publications/informations_particulieres/fiches_deficiences_emploi/Fiche05-Traumatismecranien.pdf)
- Aide aux jeunes diabétiques. (n.d.). Retrieved August 8, 2020, from <https://www.ajd-diabete.fr/le-diabete/vivre-avec-le-diabete/>
- American Association of Neurological Surgeons (AANS). (n.d.). *Traumatic brain injury*. Retrieved July 27, 2020, from <https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Traumatic-Brain-Injury>
- Association du diabète. (n.d.). Retrieved August 8, 2020, from <https://www.diabete.be/#gsc.tab=0>
- Blank, S. (2005). *The four steps to the epiphany*. John Wiley & Sons.
- Blank, S. (2013, May). Why the lean start-up changes everything. *Harvard Business Review*. Retrieved February 14, 2020, from <https://hbr.org/2013/05/why-the-lean-start-up-changes-everything>
- Blank, S. (2014, October 24). *The business model canvas gets even better - value proposition design*. Retrieved February 14, 2020, from <https://steveblank.com/2014/10/24/17577/>
- Bonnechere, B., Beauthier, J.-P., Rooze, M., & Van Sint Jan, S. (2015). Commotions cérébrales dans le sport: Est-on (pleinement) conscient des conséquences? *Revue médicale de Bruxelles*, 36, 161-165.
- Brunet, A. (2009). *Guide pour les personnes qui ont vécu un événement traumatique*. Retrieved August 8, 2020, from [http://www.info-trauma.org/flash/media-f/guide\\_pour\\_les\\_victimes.pdf](http://www.info-trauma.org/flash/media-f/guide_pour_les_victimes.pdf)
- Centers for Disease Control and Prevention. (2019). *Traumatic brain injury & concus-*

- sion. U.S. Department of Health and Human Services. Retrieved June 26, 2020, from <https://www.cdc.gov/traumaticbraininjury/>
- Expert system. (2020). *Chatbot: What is a Chatbot? Why are Chatbots Important?* Retrieved August 11, 2020, from <https://expertsystem.com/chatbot/>
- Fondation Arthrose. (n.d.). Retrieved August 8, 2020, from <http://fondationarthrose.org/Journee-Mondiale-de-l-Arthrose/Conferences.aspx>
- France AVC. (n.d.). Retrieved August 8, 2020, from <https://www.franceavc.com/>
- Groenendaels, T. (2019). *Analyse rétrospective de la prise en charge des patients admis pour commotion aux urgences du CHU de Liège entre 2009 et 2018*. Université de Liège.
- Hasso Plattner Institute of Design at Stanford (d.school). (2010). *An introduction to design thinking: Process guide*.
- Homewood Health. (n.d.). Retrieved August 8, 2020, from <https://homewoodhealth.com/individuals/clinics/treatment/mississauga-programs>
- IDEOU. (2020). *Brainstorming - Rules & Techniques for Idea Generation: How to effectively generate ideas with your team*. Retrieved August 7, 2020, from <https://www.ideo.com/pages/brainstorming>
- Institut national d'excellence en santé et en service sociaux (INESSS). (n.d.). *Traumatisme craniocérébral léger (commotion cérébrale) : Conseils pour la reprise graduelle des activités intellectuelles, physiques et sportives*. Retrieved August 8, 2020, from [https://www.inesss.qc.ca/fileadmin/doc/INESSS/Rapports/Traumatologie/INESSS\\_Depliant\\_TCCL\\_INESSS.pdf](https://www.inesss.qc.ca/fileadmin/doc/INESSS/Rapports/Traumatologie/INESSS_Depliant_TCCL_INESSS.pdf)
- KCE (Centre Fédéral d'Expertise des Soins de Santé). (2016). *Exclure les lésions cérébrales sévères après un traumatisme crânien léger*. Retrieved August 8, 2020, from [https://kce.fgov.be/sites/default/files/atoms/files/807409-KCER4Y\\_dec2016\\_FR\\_0.pdf](https://kce.fgov.be/sites/default/files/atoms/files/807409-KCER4Y_dec2016_FR_0.pdf)
- KCE (Centre Fédéral d'Expertise des Soins de Santé). (2016). *Un test sanguin pour éviter les scanners après un traumatisme crânien ?* Retrieved July 29, 2020, from <https://kce.fgov.be/fr/un-test-sanguin-pour-eviter-les-scanners-apres-un-traumatisme-cranien>
- Kelley, D. (2012). *How to build your creative confidence*. Retrieved August 6, 2020, from [https://www.ted.com/talks/david\\_kelley\\_how\\_to\\_build](https://www.ted.com/talks/david_kelley_how_to_build)

- \_your\_creative\_confidence#t-266541
- Kelley, T. (2001). *The art of innovation* (Vol. 10). Broadway Business.
- Kelley, T., & Kelley, D. (2013). *Creative confidence: Unleashing the creative potential within us all*. Currency.
- Kimbler, D. E., Murphy, M., & Dhandapani, K. M. (2011). Concussion and the adolescent athlete. *The Journal of neuroscience nursing : journal of the American Association of Neuroscience Nurses*, 43(6), 286–290. doi: 10.1097/JNN.0b013e31823858a6
- King, N., Crawford, S., Wenden, F., Moss, N., & Wade, D. (1995). The rivermead post concussion symptoms questionnaire: a measure of symptoms commonly experienced after head injury and its reliability. *Journal of Neurology*, 242, 587-592. doi: 10.1007/BF00868811
- Laly Foundation. (n.d.). Retrieved August 8, 2020, from <http://www.lalyfoundation.com>
- Laureys, S. (2016). *Brain concussion : Shake it and you break it*. Youtube. Retrieved March 29, 2020, from <https://youtu.be/5nBqLwg2Eug>
- Le Noyau aslb. (n.d.). *Association de familles et de personnes traumatisées crâniennes et cérébrolésées*. Retrieved August 8, 2020, from <http://lenoyauasbl.be/>
- Lugo, Z., Pellas, F., Blandin, V., Laureys, S., & Gosseries, O. (2017). Assessment of needs, psychological impact and quality of life in families of patients with locked-in syndrome. *Brain Injury*, 31(12), 1590-1596. doi: 10.1080/02699052.2017.1347277
- Mayo Clinic. (n.d.). *Traumatic brain injury*. Retrieved July 28, 2020, from <https://www.mayoclinic.org/diseases-conditions/traumatic-brain-injury/symptoms-causes/syc-20378557>
- McAllister, T., & McCrea, M. (2017). Long-term cognitive and neuropsychiatric consequences of repetitive concussion and head-impact exposure. *Journal of athletic training*, 52(3), 309–317. doi: 10.4085/1062-6050-52.1.14
- MEES. (2015). *Rapport du groupe de travail sur les commotions cérébrales qui surviennent dans le cadre de la pratique d'activités récréatives et sportives*. Ministère de l'Éducation et de l'Enseignement supérieur (MEES) du Québec. Retrieved August 15, 2020, from [http://www.education.gouv.qc.ca/fileadmin/site\\_web/documents/](http://www.education.gouv.qc.ca/fileadmin/site_web/documents/)

- loisir-sport/rapportgroupe detravail\_commotions.pdf
- National Institutes of Health (NIH). (2016, January 12). *Traumatic brain injury (TBI): Condition information*. Retrieved April 23, 2020, from <https://www.nichd.nih.gov/health/topics/tbi/conditioninfo/default>
- Ontario Neurotrauma Foundation (ONF). (2017). *Guideline for concussion/mild traumatic brain injury and prolonged symptoms, 3rd edition, for adults over 18 years of age*. Retrieved June 26, 2020, from <https://braininjuryguidelines.org/concussion/>
- Osborn, A. (1942). *How to think up*. McGraw-Hill book company, inc.
- Osborn, A. (1953). *Applied imagination: Principles and procedures of creative thinking*. Scribner.
- Osterwalder, A. (2012, September 6). *Test your value proposition: supercharge lean startup and custdev principles*. Retrieved February 14, 2020, from <http://businessmodelalchemist.com/blog/tag/eric+ries>
- Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.
- Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2014). *Value proposition design: How to create products and services customers want*. John Wiley & Sons.
- Pearce, A. (2019). *The potentially long-lasting effects of concussion*. The Royal Australian College of General Practitioners (RACGP). Retrieved July 20, 2020, from <https://www1.racgp.org.au/newsgp/clinical/the-long-lasting-effects-of-concussion>
- Powell, J. W. (2001, September). Cerebral concussion: Causes, effects, and risks in sports. *Journal of athletic training*, 36(3), 307–311.
- Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Books.
- Savoia, A. (2011). *Pretotype it: Make sure you are building the right it, before you build it right*. Academic Press.
- Strategy Beam. (2017). *The benefits of an FAQ page (and the most important pieces) for your business*. Retrieved August 11, 2020, from <https://www.strategybeam.com/blog/the-benefits-of-an-faq-page-and-the-most-important-pieces-for-your-business/>

- Strategyzer. (2020). *The value proposition canvas*. Retrieved June 25, 2020, from <https://www.strategyzer.com/canvas/value-proposition-canvas>
- The Ottawa Hospital. (2016). *Introduction à la commotion cérébrale*. Youtube. Retrieved August 8, 2020, from <https://youtu.be/W7ct0NXb0yI>
- The Ottawa hospital. (2020). *How to recognize the symptoms of a concussion*. Retrieved June 26, 2020, from <https://www.ottawahospital.on.ca/en/youre-in-my-care/how-to-recognize-the-symptoms-of-a-concussion/>
- World Health Organization. (2020). *Neurological disorders: Public health challenges*. Retrieved July 20, 2020, from [https://www.who.int/mental\\_health/neurology/neurodiso/en/](https://www.who.int/mental_health/neurology/neurodiso/en/)