

Sensory stimulation

A review of how stimulation of the senses can affect the behaviour of people with dementia, and inspire the process of designing for them.

Åshild Drønen Herdlevær
Department of Product Design
Norwegian University of Science and Technology

ABSTRACT

Stimulation of the senses has proven effective to provide motivation, alertness and peace for people with brain injuries, dysfunctional sensory integration and dementia. This article introduces the reader to the symptoms of dementia and the theory of and experiences with Sensory Stimulation. Towards the end it discusses how Sensory Stimulation affects people with dementia and how it is utilized. The article concludes with how Sensory Stimulation can be of interest for Industrial Designers when designing for the user group. Sensory Stimulation has shown positive to people with dementia and cognitive injuries, as it can make them more alert and aware of the situation present. Hence, consciously use of Sensory Stimulation when approaching people with dementia as designers can be an interesting area for further research and development.

KEYWORDS: sensory integration, sensory stimulation, senses, dementia, challenging behaviour, industrial design, TPD4505

1. INTRODUCTION

"On our way to Wellington we stopped for two days in Singapore. The cabride from the aeroport to the hotel in Singapore was a nightmare for her. The traffic was dense and the speed was high. She was terrified, lying down in the backseat of the cab, holding on for her life."
(The Road into the Land of Mist)
[41]

We are to a large extent influenced by our surroundings, and the design of our environment and the objects and services in it affect our quality of life. This implicates that the way we experience the surrounding world is through our senses[1]. Our brain has the important role of percieiving and interpreting the impulses from our senses, and makes us understand the world and our bodily orientation in it [2].

When a person develops dementia, the brain's functionality gets gradually reduced[18]. People with dementia might find it difficult to communicate, to focus on a certain task or to interact with the objects and people in the surrounding environment. Their sense of space and time is reduced, and the symptoms of the disease can make them apathic and take less initiative to activities [25]. However, a person with dementia's capability to sense the surrounding environment is not affected by the disease. The ability to comprehend and integrate the sensory impulses correctly can be reduced [1], making people with dementia vulnerable for overstimulation of the senses.

Sensory Integration is a theory of how stimulating the senses can affect how we react to different situations [2]. The principles of this theory have for some time been used in therapy for patients with brain injuries [3] and children with a dys-

function of sensory integration [5]. Birgitte Christensen is a danish ergotherapeut familiar with the method of Sensory Integration in therapy for people with different brain injuries [3]. She noticed as a common problem that a person who does not perceive himself or the outside world in a correct manner can experience difficulties when collaborating with the therapist, and the training becomes exhausting. Previously, when patients struggled with motivation and cooperation, therapy was just put to an end. However, Christensen noticed that different sensory stimuli before therapy made the person more awake, alert and willing to cooperate [3]. The same experience showed at other patients who struggled with cognitive impairment in form of bodily disturbance, space and orientation problems and anxiety.

In Norway, research was started recently to experiment with techniques for sensory stimulation in dementia institutional care [1]. Results show that people with advanced dementia are reacting in a positive manner to sensory stimulation, less apathy and more initiative to social interaction are some of the positive outcomes [1].

The objective of this article is twofold: first, it aims to provide the reader with an understanding of dementia and its most common symptoms, as well as introducing the reader to the theory of Sensory Integration. The second part aims to create links between the symptoms of dementia and how sensory stimulation can contribute to ease communication and daily activities [1]. Furthermore, it aims to uncover research on and experiences with sensory stimulation, and point toward further research areas, especially when it comes to the research field of design.

2. RESEARCH METHODS

The research for this article is based on a literature review: scientific articles, books

on the subject and media from professional institutions such as The Norwegian Institute for National Health have been of interest. To understand the complex situation of dementia is a demanding process, and an extensive research into the area is necessary. Webpages like The Helen Hamlyn Centre, The Norwegian Government and The Norwegian Design Council have been of particularly help and interest, as well as documentaries made by "Puls" to get insight in the Norwegian Health Care system. The book "The Road Into the Land of Mist" written by Ola Hunderi [41], whose wife developed early onset dementia has been of great inspiration.

Research within the areas of science and health, psychology and design has been important to understand and get knowledge about the themes of both dementia and sensory stimulation.

3. ABOUT DEMENTIA

3.1 Dementia in Norway

In Norway it is assumed that around 71 000 people the age of 65 or above suffer from dementia [16]. Each year 9000 Norwegians are diagnosed with the disease [17]. The number of people being diagnosed with dementia under the age of 65 is around 1 500 each year. There are even types of dementia detected with people in their thirties and forties [18]. These people are in the middle of their working careers, and about one third has children under the age of 18. However, there are big uncertainties in these numbers due to lack of good diagnostics and knowledge about what symptoms to be aware of [19]. Around 50 percent of people suffering from dementia live in an institution; the other part still lives at home, either alone, with a partner or another carer [12].

3.2 The disease and its symptoms

Dementia is described as an extensive

failure of cells in the brain; it is a cognitive impairment that occurs without the person losing consciousness. The disease is progressive, which means that it goes through several stages, and eventually will lead to helplessness and hospitalization [13]. The Berger-scale splits the development of the illness into six steps, depending on the subject's functional ability [14]:

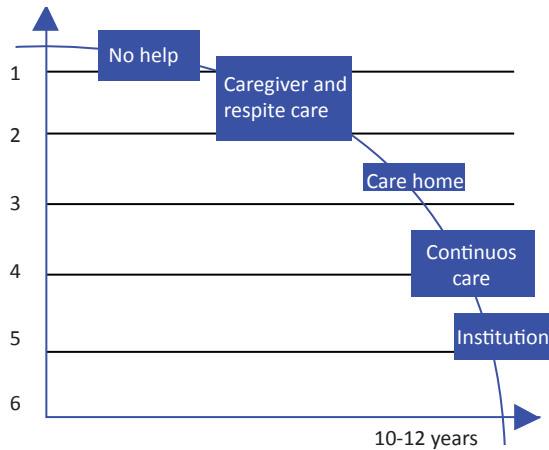


fig.1 The Berger Scale

1. Forgetful and challenged in daily activities.
2. Can do regular activities, but is often confused.
3. Can manage in known surroundings and situations, but has big cognitive problems. Needs reminders, and shows lack of initiative.
4. The sufferer has difficulties with language and actions.
5. Cannot communicate verbally.
6. The motorical functions are affected, and the person needs care 24/7.

The first three steps imply that the person can manage in his or her own home, with help from home services, day care offers and family care. The person easily forgets appointments and numbers, and to do tasks like cooking or dressing properly [15]. The ability to learn decreases, repetitive information is needed and the person

can experience difficulties finding the words when communicating [26]. Changes in functionality often cause depression, anxiety and insecurity, and result in social isolation [26].

Step 4 on the scale indicates close follow-up. In this stage the patients struggle to use their normal abilities and find it difficult to make decisions. The capability to keep their house in order also gets strongly reduced [15] and they might not care as much about personal hygiene [26]. Problems with time and space orientation becomes prominent, and aggressiveness and challenging behaviour might occur when confused and stressed [26]. At step 5 and 6 the person is completely helpless at home, even with health service and support from their family. When the disease reaches this step, institutionalization in a nursing home or in a care home is advised [13].

The symptoms also include lack of insight, lack of judgment and changes in mood, behavior and personality [12]. As many as 80% of the sufferers develop depression [13], which again can result in social isolation, passivity, sleeplessness and lack of appetite. In many cases they lose interest in activities and hobbies that were previously important to them. They also stop gradually with actively and emotionally shaping their surroundings [13].

Alzheimer's disease is the most common cause of dementia, and at present there are no known medical cure for this cognitive disease.

3.3 The family and caretakers

As long as the person with dementia is living at home, normally during the three first steps on the Berger's-scale, the family is in many cases the most important caretaker [5]. Research confirms that taking the role as the main caregiver for a person with dementia increases the risk for impairment of own health. The family members are exposed to great strains and

stress when helping with practical tasks, and they are often affected negatively by the symptoms their beloved shows [5]. International studies show that the carers consult with their doctors more often and get more prescriptions for psychotropic drugs [5][19]. Many are struggling with depression and anxiety. In most cases, it is the behavioral changes and the psychological symptoms the person with dementia shows that are affecting the carers most negatively [13].

3.4 Behavioral changes and psychological symptoms

Challenging behaviour, also called APSD (Atferdsmessige, Psykiatriske, Symptomer ved Demens) [28] is so commonly found in people with dementia that it is mentioned as a part of the dementia syndrome, concluded at the conference at International Psychogeriatric Association in 1996 [11]. At the conference they divided APSD in behavioural and psychological symptoms [27]. Common behavioral symptoms are physical aggression, shouting, unrest, agitation, wandering, inappropriate behaviour and lack of sexual inhibition. The most common psychological symptoms are anxiety, depression, hallucinations and delusions [29].

Engedal [26] defines challenging behaviour as "an undesirable pattern of behaviour that can not be explained by the course of dementia, but as a result of the person with dementia's understanding or lack of understanding of the environment and interaction with the environment, arising from the understanding or lack of understanding that exists"[11]. This definition moves the focus of aggressive behaviour being a problem with the person with dementia, to it being a result of problematic interactions with the environment [26].

4. OUR SENSORY SYSTEM

We experience the world through our sensory system. The system gives us impulses that enable us to interpret what is in our environment and how our body function in it. Our 5 main senses are [5]

- Touch – tactile
- Sound – auditory
- Sight – visual
- Taste – gustatory
- Smell – olfactory

In addition to these, there are two other powerful senses [5]:

- Vestibular (movement and balance sense) – provides information of the position of head and body in space, in relation to the earth's surface [5].
- Proprioception (joint and muscle sense) – provides information about the placement of the body parts, and what they are doing [5].

The tactile sense has receptors that lies in the skin, and tells a person when it is being touched or touches something [1]. The sense has two functions that communicate to the brainstem. The discriminating sense is soothing, and decides how much the person should react to the alarming sense, that conveys pain, temperature and releases emotional reactions [1]. People with a reduced tactile sense can react in a negative way when being touched by others if it happens without knowing about it [2]. Some can be sensitive towards wearing clothes, others by a new ring. They might not like to be close to others, have problems with their concentration and have poor motorical skills [3].

The auditory sense, hearing, is the ability to perceive and interpret sound by detecting vibrations in our surroundings [38]. The use of focused sounds produces an effect on the nerve system, and can as an example help people develop or recover language skills, soothe and agitate

behaviour [39]. A person with a well modulated auditory system will detect noise in a way that will not affect the greatly in daily life [40]. A person who is hypersensitive to sound will often be distressed by loud noises, frequently avoiding crowds and get annoyed. The opposite is seen at people who are under-responsive to auditory stimuli [40].

The visual sense, sight, makes us able to interpret the surrounding environment by processing information that is contained in visible light [34]. As our vision is one of our most important senses [36], it is the focus of much research in psychology, cognitive science and neuroscience. Hermann von Helmholtz, a researcher, concludes that the eye is actually optically poor, but the vision is a result of an unconscious inference: a matter of making assumptions and conclusions based on previous experiences [35]. Visual stimulation for Alzheimer's patients can involve light, colour, shape and motion, and can amongst other affect the body's natural clock.

The gustatory sense, taste, is the perception of chemicals in the air or in our food [37]. The senses of taste and smell are intimately entwined, and enhances the perception of the foods we eat [37]. When the sensory cells in the taste buds are stimulated, they cause signals to be sent as impulses along cranial nerves to the brainstem. From here, the impulses are sent to a specific area of the brain that makes us conscious of the perception of taste [37].

The olfactory sense, the smell, quickly stimulates the limbic system [5]. The limbic system is a collective term for the part of the brain that regulates the autonomic functions, like breathing and blood pressure. It affects our sexual behaviour and our emotional reactions like fear and anger [8]. An area within the limbic system is the hippocampus, which plays an important role for memory and learning abi-

lities [8]. Stimulation of the olfactory sense can wake a person that is half a sleep [3].

The sense of balance, the vestibular sense, has its receptors in the inner ear, which make up the balance organs [1]. They register and affect the balance, speed and feeling of equilibrium. The vestibular sense also gives us information on the position of the head at any time. [3]. Many people with dementia experience difficulties lying in a bed, feeling like they are falling. Experience shows that some are calmer if they are moved lower in height, lying on a mattress on the floor. People with dementia might also experience problems with orientation and understanding of space, and can for example miss their chair when sitting down [1].

The joint and muscle sense, also called the proprioceptive sense, is important for the recognition of the muscles and joints tension condition, position and movement [1]. This sense makes it possible for us to experience how we function in space, in coherence with the environment. People with a reduced proprioceptive sense can have clumsily motorical movements, difficulties with placement and reduced stability. Lack of stability makes it difficult for the body to stay calm [3].

From a medical point of view, how we process sensory information affects our ability to obtain information from the body and the environment, in order to physically interact with people and objects [7]. In addition, it affects the ability to modulate sensory information, that makes us able to adjust to circumstances and maintain concentrated on the task at hand [30]. However, one should also consider that sensory information relates strongly to humans' state of alertness [7] as well as it influences emotional and social interaction. All these aspects play roles the practical system of our senses.

4.1 Under stimulation, over stimulation

A common result of a person having dementia is social isolation and passivity. When a person is under stimulated over a longer period, the sensory problems are affected and enhanced [3]. Deprivation of sensory input creates chaos in the brain even for cognitively healthy people. Under-stimuli can result in difficulties with concentration, inattention, indifference and serious hallucinations [1]. However, it is also important to prevent over stimuli of the senses. People live in stressful environments, over stimulated by light, TV, radio and other noise at all times. An environment can create anxiety and stress for people with dementia, as they do not possess the ability to handle multiple sensory stimulations at once. [1]

" "Be quiet", she nearly shouted. It was a Saturday in early December 1997, and we had invited our best friends for dinner. (...) Everybody fell silent. This was so unlike her. Most of the times she was quiet and somewhat withdrawn, although she could at times be a party person." (From "The Road into the Land of Mist, Ola Hunderi) [40]

5. SENSORY INTEGRATION AND STIMULATION

Ergotherapist Christensen [3] worked with a young man who suffered from a severe brain injury. During 6 months he was fed through a probe while lying in bed.

" When we tried to feed him naturally, we got kicks, bites and torn of hair in return. First when we were three nurses that gave him sturdy sensory stimulation of face, arms and legs, while a 4th person was providing him with food, he would open his mouth voluntarily. A month later he was sitting in a chair, eating all meals for himself" [3].

The theory of Sensory Integration was developed more than 30 years ago by A. Jean Ayres, an occupational therapist with expertise in neuroscience and educational psychology [6]. Ayres defines sensory integration as "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment" [5]. The theory is amongst other described in the book "Sensory Integration – theory and practice" [2], and is used to explain the relationship between the brain and behaviour, and why individuals respond in a certain way to sensory input and how it affects our behaviour [5]. Her theory is mainly focusing on children with Dysfunctional Sensory Integration, helping the children to better cope with everyday situations [5].

Our functional abilities are reduced when the brain does not have the ability to organize and separate information received from our senses [1], something people with dementia can experience. The most important condition for learning and experiencing is the brain's state of awareness [1]. This state is controlled by the brainstem, that sends inhibitory and enhancing impulses that can be affected through provoking or soothing stimulation [1]. In the neurological mindset it is the tactile sense, the joint- and muscle sense and the sense of balance that are affecting the impulses to the brainstem the most [3]. These senses have been mapped to a greater degree than the impact of smell, sight, taste and hearing sense [3].

5.1 How has sensory stimulation showed to affect behaviour.

"When my husband is in the bath tub he is less tender than when he is not. He hurts if we are touching him outside of the tub." (A care giver's statement in the article "The Tender Old") [4].

"With increasing age we become more dependent on our previously learned skills. The skills can get passive when not being used, but they do not disappear. In my experience music can affect the brain to open such zones." (Audun Myskja, neurologic music therapist) [31].

Birgitte Christensen [3] writes about how the Sensory Integration principles can be used in the treatment of geriatric and neurological patients at the Hospital of Vordingborg in Denmark. She claims that people with dementia living in an institution were more awake and alert when brought to the ergotherapist by someone who transported them in a fast manner: their vestibular senses was stimulated before the ergotherapist session, making them more receptive of sensory input.

"A 22 year old patient suffered from a brain injury with memory problems. He gave the impression that really wanted icecream. He was guided to the kitchen, where he, with some help for balance, made his own icecream from scratch, using different types of ingredients. This was a great sensory stimulation for the patient, and the next day he could remember what he had made the day before, for the first time in a very long time." [3]

Vibeke Hasselø, ergotherapist at the University Hospital of Oslo, has experience with sensory stimulation mainly from geriatric care, dementia care and psychiatric care. She has used sensory stimulations to prevent unrest and to better night's sleep and has good experiences with the methods. Types of sensory stimuli she uses most often on her patients are music, massage with lavender oil and heat packaging [1].

"A person that wanders can be stimulated by walking outside in fresh

air. Someone who was previously concerned with caring for themselves can be stimulated by massage with aroma oils. Massage with lavender oil gives physical contact that seems calming. These stimulations can reduce amongst other sleep problems. A hard massage with a towel is a stimuli that activates the receptors in the brain that soothes the alarming system." (Vibeke Hasselø) [1].

When it comes to visual stimulation for people with dementia, the most common is bright light therapy [36]. The area of the brain that is affected by dementia also regulates our body's natural clock for waking and sleeping time [36]. Because of this, people with dementia often suffer from sleep disorders, which in turn enhance irritability and confusion. Bright light therapy externally re-sets the body's natural clock. A passive procedure, that can be affective for sleep and mood enhancement, especially during the winter [36]. Other visual stimulations used in dementia care is videos and nature walks, combining several sensory stimulations [36].

A bodily contact with one self can be enhanced through stimulation of the sensory system. Stimulation of the tactile sense works directly on body coordination and motorical skills. Through stimulation of the tactile and proprioceptive sense people get a leveled feeling of their body, which can make it easier to perform tasks such as those with personal hygiene [1]. It is also showed that stimuli of the senses triggers the relaxation hormone Oksytosin that reduces the level of stress [3].

Results from a Multi-Sensory Stimulation trial from 2010, showed that immediately after the sessions the patients, who suffered from dementia, talked more spontaneously, related better to others, did more from their own initiative, were less inactive and seemed more happy and

alert [10]. The patients were more attentive to their environment than before, and showed a significant improvement in mood and behaviour. However, no longer-term benefits were found when the research team met the patients one month after the trial [10].

6. DISCUSSION AND FURTHER RESEARCH

According to Audun Myskja [31], doctor and neurological music therapist, our sensory system has a limited ability to accommodate multiple types of experiences at the same time. States such as anxiety, depression, and pain can block the rest of the system, making it hard for other input to come through the barrier [11]. Sensory stimulation by for example listening to a certain type of music, can provoke a euphoria where response can be found in the mid-brain. This response challenges the fundamental state of anxiety, depression or pain, relieving the patient from the symptoms [31]. However, Myskja also states that this sensory stimulation does not cure diseases nor brain injuries, and he uses it as a supplement to regular medical treatment. It has shown to relieve some patients from their state of illness for a while [11].

"The rhythm of a metronome can better the walk of patients with Parkinson" (Audun Myskja) [31].

Sensory stimulation is a method whose success has been well documented within the area of treatment of children with Dysfunctional Sensory Integration and in ergotherapy for people with different types of brain injuries. It has to some extent been used on people with dementia to cope with the symptoms of challenging behavior. This behavior is what affects the care givers the most, as the person they are caring for might never have shown these sides when healthy [13]. Its' success is therefore of great interest for people living with dementia, and those caring for them at home. However, the research

conducted for this article found next to no research on sensory stimulation for people living at home. Most research is done by ergotherapists on patients with advanced dementia, living in care homes or other institutions. There might be several reasons for why this usergroup is poorly represented, but reasons I can draw from the article is the complexity of personal experiences and tolerances. The approach to which sensory stimulation is done is crucial to the success of the stimuli, and the degree of sensory stimulation must be adapted to individual preferences, and activate resources the person still possesses [1]. Gathering of personal information requires an extensive mapping process, which can be difficult to conduct when a person is living at home. In addition, the ability to process impulses will most likely decrease when the disease is progressing, making sensory stimulation something that always must be adapted to the persons' current level of ability. It might be a challenge to educate care givers on this matter. However, when done right, sensory stimulation can contribute to level a persons quality of life, and reduce the need for psychotic medication [1] [11]. With some help, a person with dementia can maintain and even recall previously learned functions [11].

The research done also shows little experience with sensory stimulation of the visual and taste sense. This I find a bit surprising, after all these senses are powerful, prominent and should be easy to stimulate. There is also little to no research found on sensory stimulation person-to-object. The experiences presented in this article include person-to-person interaction, and not only through products or elements. An exception is Audun Myskja's musical therapy, which can stimulate the auditory sense without any person-to-person interaction [31].

Another interesting aspect is that of the pharmaceutical. Many people with dementia are taking psychotic drugs due to

"challenging behaviour". Side effects of these drugs are apathy and inactivity [26]. When people show lack of interest for their surroundings they might get less attention from their care givers. After all, they are calm and at peace sitting in their favourite chair. One should definitely consider a more prominent use of sensory stimulation within dementia care, both for soothing and aggritation of behaviour, as it could reduce a person's need for psychotic drugs making them apathic and more isolated.

In addition one should consider the ethical aspect of sensory stimulation, as it can be seen as a manipulation of a person's reactions to a desirable behaviour. A person sitting in a chair, exhausted by over stimuli, is of less concern to the staff or a care giver, than someone wandering about.

According to findings from the research, sensory stimuli has no long-term effect. On the other hand, it can be believed that for a short term task, the right stimuli can make a person more alert and focused for the time being. An interesting research area with lack of results is thus the effect of sensory stimulation for (younger) people with dementia living at home, during the three first steps of Berger's scale [14]. For future research and development within the design field, it could be interesting to see whether any success could be done by "sensory workshops" when including people with dementia, their carers and other stakeholders in a design process. Sensory priming before conducting the actual workshop, with activation of different senses through stimuli, could perhaps increase the effectiveness of the workshop and design process by opening the brain areas that control focus and awareness.

As a summary of the findings on sensory stimulation and how it can affect the behaviour of people with dementia, I made a matrix for the reader to easily see the

research and connections (see table 1, next page)

Sense	Main functions	Affects	How to stimulate
Tactile	Feeling of touch – discriminating and alarming sense.	<ul style="list-style-type: none"> The brain's awareness Awakeness Concentration and focus 	<p>To wake the alarming system:</p> <ul style="list-style-type: none"> Rapid, large movements Light touching <p>To wake the discriminatins system (soothes the alarming system):</p> <ul style="list-style-type: none"> Heat Solid touching Massage
Auditory	Sound – Ability to interpret sound by detecting vibrations in our environment.	<ul style="list-style-type: none"> The nerve system Behaviour: calm, aggitated Reminiscence 	<p>Aggitate awareness*:</p> <ul style="list-style-type: none"> Quick rhythm Laughter <p>Soothe behaviour*:</p> <ul style="list-style-type: none"> Uniform rhythm Structured music Familiar
Visual	Sight – Our most important sense. Interpret the surroundings by processing information in visible lights..	<ul style="list-style-type: none"> The brainstem Body's natural rhythm Reminiscence 	<ul style="list-style-type: none"> Bright light, colour, shape and motion, contrasts.
Gustatory	Taste – Perception of chemicals in the air and food.	<ul style="list-style-type: none"> Impulses to the brainstem Counciousness and awareness of the brain. 	

Table 1

***Agitate awareness:**

Helps the brain to process relevant stimuli. Influencing the thinking and the center for emotions. Poor awareness causes lethargy and apathy, and makes the person not respond adequately. Poor motivation for activity [1].

***Soothe behaviour:**

Prevent and reduce agitation. Soothing stimulation inhibits and organizes the flow of impulses to the brain, making the person feel calmer. Contributes to an increased bodily awareness and physical limitations [1].

7. CONCLUSIONS AND FINDINGS

The research this article presents shows that sensory stimulation definitely has a positive effect on challenging behaviour found with people with dementia. It is also reason to believe that it can affect other aspects as well, such as increase concentration and improve communication skills, inactivity and reduce apathy. My literature conduction found little to no reseach about use of sensory stimuli in the design process, and especially not for people with dementia and those living at home. This is an area with a potential for interesting research and I believe that increasing the knowledge of sensory stimulation for people with dementia and other cognitive

impairments could help generate success when designing for people in this user group. People with dementia experience senses in other ways than those without dementia, and as designers it is important to meet them at their level and premisses. An understanding of the sensory system and how stimulation can affect it, is thus important for communication and empathy. From the research I draw the conclusion that by integrating elements of sensory stimulation we can in the end facilitate a better experience of interaction with technical remedies, services, products and people for those with dementia as their carers.

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