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Multisensorial movie: how Taste and Tactile integrations influence memory, interpretation and experience.

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Abstract

Multisensory integration is about the combination of information coming from two or more senses to elaborate a coherent percept. With this experiment we wanted to study its manifestation at a high level, so the way it modifies the perception of a rich context, like watching a movie. In this experiment we investigated the way it changes the experience, the interpretation of a determinate scene and the performance in a recall task in participants that had to watch 3 clips from the movie "Youth - La giovinezza" by Paolo Sorrentino while being stimulated through tactile or taste stimuli. In each clip, a participant could be in one of three conditions: control group, congruent group and incongruous group. To collect the data we used two methodologies: participant observation and a survey filled by the participant at the end of each clip. The results showed that multisensory integration influences the experience by increasing positive feelings coherently to positive scenes, influences the interpretation of the characters' emotions and obstructs the recalling of details.

Keywords: multisensorial integration, movie, QoE, memory, experience, interpretation, multimodality

Introduction

Life is multisensorial. We relentlessly integrate information gathered from different modalities to build a robust and coherent perception of reality. We are constantly surrounded by a multitude of different information which we have to analyze and process.[1] The circumstances are the same while watching movies: we collect data from the scenes in front of us and we pair them with the audio to understand the narrative. Movies represent an experience where what we are perceiving is, in a certain degree, artificial and controllable. Therefore during these experiences we can integrate additional "stimuli", at present: popcorn, chips, candies and all kind of food and beverage has been introduced.

Since the very nature of narrative of visual and audio-visual contents is to communicate, elicit and express emotions, therefore, we can think about manipulating the stimulation to better understand the role the different modalities play to product a consistent percept.
We hence investigated which influence, gustatory and tactile stimulation, could have on various aspects of movies fruition. The primary aspect worth to be inquired is the modification that the introduction of additional, and perhaps odd, sensory cues has over the viewer's emotional engagement. Although the role of movies is to communicate certain emotions, the interpretation of the scenes is personal so is liable to shifts if the movie is displayed in different conditions: is our interest inquire if stimulation coming from different senses in addition to sight and hearing are able to provoke a variation.
Since food is linked to social and cultural variables, it is capable of conveying meaning and information, therefore, we can consider it as a mean for multisensory storytelling.[2] The addition of different modalities than the classic food and beverages stimulation has already been implemented in different scenarios like 4D-cinemas: in these conditions, tactile perception has been integrated to give shape to new watching experiences.
We hence decided to study the influence these two different modalities have over the perception of the movie. The degree in which a perception could be influenced are various, the first it comes to mind is the personal experience: this aspect is evaluated through phenomenological and anthropological inquiry methods.[3] Although, in order to give a more statistical point approach and infer relationships between modalities, another measurement should bring in the experiment classical cognitive science metrics. Another important aspect of movie fruition is the memory the watcher has of the movie: memory tasks are thus used to evaluate possible differences and provide statistical data to support the research.
The third aspect that has been inquired is the possible shift that multimodal stimulation could have over the interpretation of a scene: if the understanding of the narrative can incur in changes and modifications due to different types and modalities of stimulation.
How can a tactile and taste stimulation be related to events occurring in a movie? The correlations we took into account were the ones related to glaring facts happening in the scenes: a set of an old couple' multiple meals, a man having a massage and a harsh discussion between two gentlemens. Each scene contained blatant features and traits, they all conveyed a message – or a particular event occurred. The perception of these characteristics could change as well between the same modality of stimulation. Hence, the stimulation can be treated as cues: influencing the perception towards different outcomes. Thus, the introduction of a semantically congruous and incongruous stimulation facilitated the inquiry over the dynamics of interaction of stimulation that diverged or reinforced the clip's message.[4]

Research questions

Interpretation

While watching a movie, does the addition of multisensory stimulation change the participant interpretation of the character's emotions?

Experience

Does the addition of multimodal properties to a movie change the experience of watching it?

Memory

While watching a movie, does the addition of multisensory stimulation change the performance on a memory task?

Methods

Participants

We recruited 11 participants in total – 6 men and 5 women – 8 participants were Italian Erasmus students with an age range from 20 to 26, meanwhile, 3 had Italian roots, for example, an Italian parent or Italian grandparents, and had spent in Italy from 6 months to multiple years. Every one of them had at least a C1 level in Italian. They were randomly divided into the three conditions and clips as reported in Table 1.

	Control	**Congruent stimuli**		**incongruous stimuli**	
Clip 1 - Taste	SM, FR, GR, DG	EM, IS, MM, FI		AP, FC, JC	
Clip 2 - Tactile	EM, IS, MM, FI	AP, FC, JC		SM, FR, GR, DG	
		Tactile: Cong Taste: Cong	**Tactile: Cong Taste: Incong**	**Tactile: Incong Taste: Cong**	**Tactile: Incong Taste: Incong**
Clip 3 - Tactile+Taste	AP, FC	DG, SM, JC	FR, GR	EM, IS	MM, FI

Table 1

Materials

The participants were seated in front of a 46'' LCD television at a distance of 2,5 m and wore a Sony Bluetooth headset.
The room used for the experiment was inside the university and was reserved to avoid people disturbing the experiment.
We cut and assembled multiple parts of the movie "Youth" by Paolo Sorrentino to make three clips:

Clip 1 – Old Couple Eating [Taste]:
Minutes: 25:21 - 25:59 / 29:32 - 29:40 / 40:34 - 41:39 / 42:12 - 43:56
Total length: 1.50 minutes

Clip 2 – Massage [Tactile]
Minutes: 15:02 - 17:12 / 54:01 - 55:06
Total length: 3.16 minutes

Clip 3 – Conversation [Taste+Tactile]
Minutes: 2:22 - 5:15
Total length: 2.56 minutes

	Congruous	**Incongruous**
Taste stimuli	Hot vegetable broth Granny Smith apples [Sour]	Cold lemonade (Pulco citron vert 1,5 L) Gala apples [Sweet]
Tactile stimuli	Liniment + skin contact (Biolane Oleo) Aluminum foil	Semolina + latex glove contact Silk cloth
Other materials	Stopwatch, kitchen knife, toothpicks, thermos, plastic glasses.	

Design

The experiment had two different stimulation modalities: tactile – taking place on the participant's palm – and taste.
The first two clips analyzed their effects separately: the first clip implemented the tasting stimulation, the second clip the tactile stimulation; the third clip analyzed the effects of the modalities combined.

Each clip had three different possible conditions: a control condition, a congruent condition – where the stimulus matched what was happening in the scene – and an incongruous condition where the stimulus was the opposite of the ones in the scenes.

Table 2 outlines the stimuli and the conditions in which they occurred.

	Control	Congruent stimuli		Incongruous stimuli	
Clip 1 - Taste		Hot vegetable broth		Cold lemonade	
Clip 2 - Tactile		Liniment + skin contact		Semolina + latex glove contact	
		Tactile: Cong **Taste: Cong**	**Tactile: Cong** **Taste: Incong**	**Tactile: Incong** **Taste: Cong**	**Tactile: Incong** **Taste: Incong**
Clip 3 - Tactile+Taste		Aluminum foil Granny Smith apple	Aluminum foil Gala apple	Silk cloth Granny Smith apple	Silk cloth Gala apple

Table 2

The tactile stimulation was carried out by one experimenter touching the palm of the participant with the liniment with skin-to-skin contact, semolina with the experimenter wearing a latex glove, an aluminum foil or a silk cloth; each of them depending on the condition and clip we were experimenting. The tasting stimuli happened in two different ways depending on the stimulus whether it was to be drunk or eaten. For the former, the experimenter put a glass in the hand of the participant and he would drink it; for the latter, the experimenter first touched the participant's shoulder who would then open the mouth and receive the food – held in a toothpick – by the experimenter. The participant received the stimuli by an experimenter of the same sex.

In each clip, every stimulation lasted five seconds and was administered according to what happened in the scene In the first clip, they were administered respectively at 0:10 and 1:15; in the second clip at 0:15, 1:50, 2:30 and in the third clip at 0:21, 1:05 and 2:40.

The experiment lasted for approximately 30 min.

Measures

In the pre-experiment survey, besides name and age, we asked the participants email, if they had any food intolerance, if they had previously seen the movie "Youth" by Paolo Sorrentino and when within a range from a few months before to the release date and a rating with a Likert scale of every basic taste from "I like it a lot" to "it is disgusting".

During the experiment, every measurement taken from the participant's performance was through Google Forms. For the three clips, there was a related survey divided into three sections: interpretation, memory and experience. Every section had three copies, corresponding to the condition the participant experienced (control, congruent, incongruous).
In the interpretation section, the participants were asked to identify the emotions felt by the characters (between anger, fear, sadness, joy, surprise, contempt, disgust) and grade its intensity from 0 (not intense) to 7 (very intense); for the first clip, in addition, they were asked to give an interpretation on why the characters acted that way.

In the memory section, the participants were asked to recall some aspects of the scene and to grade how sure they were in a scale from 0 (not at all) to 7 (totally sure).
In the experience section, the participants were given a list of emotions (stress, sadness, anger, boredom, serenity, curiosity, love, subjection, shame, disappointment, disbelief, indignation, envy, hope, anxiety, relaxation) they could have felt and were asked to grade their intensity in a scale from 0 to 7.
After the third clip, before the usual survey, the participants were asked to grade the taste of the apple they ate in a scale from 0 (sweet) to 7 (acid).

Procedure

The participants were told that the goal of the experiment was to evaluate the effects of multisensorial integration during the vision of a movie.

The day of the experiment, we asked for participation and recording consent. After the subjects gave their consent, they were given the document with the instructions and one experimenter started the video recording. The experimenter then asked to sit as comfortably as possible and to keep the right arm extended in the table with the palm up. The experimenter then remarked the participant to keep attention to the clip and not concentrate on the stimulus he would receive.

The first clip (dinner scenes) would then start. At the end, after a few seconds, the corresponding survey was asked to be filled. The same process was repeated for clip 2 (massage scene) and clip 3 (garden scene), with the only exception after clip 3, when the apple taste survey preceded the usual survey.

Results

Interpretation

Clip 1

In the first question of the survey[5] (Table 3) – regarding the husband's emotion – the choice of the emotions was generally homogeneous with the control group: mostly negative or neutral feelings (Sadness and Surprise). We just saw an "outsider" in the congruent stimulation: unlike the other judgments, this participant addressed a very high positive emotion – Joy.
About the perceived intensity of the character emotion, we noticed a transition in the average intensity: the control group has proven to be the one to have the lowest average (4 points) followed by the congruent stimulation group with +1.25 (5.25 points) and the incongruous group with +1.66 (5.66 points).

Stimulus	*Quest 1: Husband's Emotions*	Intensity
Controllo - Nulla	Sorpresa	4
Controllo - Nulla	Sorpresa	5
Controllo - Nulla	Sorpresa	3
Controllo - Nulla	Tristezza	4
	Intensity Mean	**4**
Congruente - Brodo	Sorpresa	5
Congruente - Brodo	Sorpresa	5
Congruente - Brodo	Sorpresa	5
Congruente - Brodo	Gioia	*6*
	Intensity Mean	**5,25**
Incongruente - Limonata	Sorpresa	6
Incongruente - Limonata	Sorpresa	6
Incongruente - Limonata	Tristezza	5
	Intensity Mean	**5,666666667**

Table 3

Regarding the second question (Table 4) the participants addressed a different sample of emotions but it was common for every participant to choose a negative one: anger or contempt. In the congruent condition there was an outsider value – sadness – but it was anyway included in the negative emotions' range.
The intensity had a slight variation: both the congruent and incongruous stimulation resulted in a change of the mean by +0.25 points over the control group mean.

Stimulus	*Quest 2: Wife's Emotions*	Intensity
Controllo - Nulla	Disprezzo	6
Controllo - Nulla	Rabbia	4
Controllo - Nulla	Rabbia	6
Controllo - Nulla	Tristezza	7
	Intensity Mean	**5,75**
Congruente - Brodo	Disprezzo	5
Congruente - Brodo	Disprezzo	6
Congruente - Brodo	Rabbia	6
Congruente - Brodo	Disprezzo	7
	Intensity Mean	**6**
Incongruente - Limonata	Rabbia	5
Incongruente - Limonata	Rabbia	7
Incongruente - Limonata	Disprezzo	6
	Intensity Mean	**6**

Table 4

Over the questions 3 & 4 (Table 5) the influence of the stimulation was not as noticeable as in the previous results: the third question of the survey indicated as the main reason of the wife's slap the purpose of humiliating her husband (4/11).
For the fourth question we saw a slight pattern in the semantic meaning of the responses (Table MM - Column "Semantic Meaning"): in the control group most of the participants (3/4) addressed, as main reason of why the couple doesn't talk, mostly negative or tragic reasons (ie. "cheating", "end of love" etc.). If we observe in the congruent and incongruous conditions the meaning shifts towards a more neutral and natural explanation over the matter, the explanations tendeed to be less negative, addressing the motivations as mostly "customs and practices", "long wedding" and "misunderstandings".

Ques 3: Wife's slap intention	*Quest 4: Why the couple doesn't talk?*	Semantic Meaning
umiliarlo	il marito ha tradito la signora	CHEATING
Andare via dal ristorante perché turbata	Esiste un clima di tensione tra i due che ha limitato il dialogo	TENSIONS
sfogare la sua rabbia	perchè sono insieme ma il rapporto di amore è finito	END OF LOVE
umiliarlo	perché non hanno bisogno di parlare dopo tanti anni che stanno insieme. basta il silenzio	LONG WEDDING
umiliarlo	tensione	TENSIONS
Lasciarlo dopo anni di matrimonio senza amore	Perché tra loro non c'è più affetto, probabilmente da anni	END OF LOVE
Punirlo da un'offesa	Costumi moderni chic appariscenza	CUSTOMS AND PRACTICES
gelosia	abitudine, non hanno più niente da dirsi	LONG WEDDING
umiliarlo	livello sociale o educazione	CUSTOMS AND PRACTICES
Per fare parlare il suo marito	Non si comprendono	MISUNDERSTANDINGS
non vederlo mai più	mancanza di fiducia	END OF LOVE
	NATURAL/NEUTRAL REASONS	TRAGIC/NEGATIVE REASONS

Table 5

Generally, the stimulation led to a change, where the judgment of intensity was the most noticeable. The incongruous stimulation was the one where we experienced the most variation. If there was a change, in the answer about the judgment over the relationship and the motivation behind the slap, we can not say that with certainty: there were a lot of clues in the clip that may have led the participants to create their opinions about the couple. The stimulation could have influenced but the clues provided more meaningful information to build an acceptable explanation.

Clip 2

The emotion roster in the first question of the second clip[6] (Table 6) was accurate, it was composed by three emotions: joy, surprise and sadness. The recurrent emotion was sadness, it appeared in every condition. Contrary to expectations, joy was chosen in the incongruous stimulation. The congruent group had a slight variation (-0.77 point) in the intensity judgment for the massaged man's emotions, on the other hand, the incongruous group judgements did not experienced any difference in the perception.

We observed meaningful variation in the Masseuse's emotions choice: the incongruous stimulation incurred in a more heterogeneous roster than the other two groups. About the emotions' intensity we have not found any relevant change: the congruent and incongruous conditions deviated from the control group's mean by -0.08 the former and -0.25 the latter.

Stimulus	*Quest 1: Massaged Man' Emotions*	*Intensity*	*Masseuse' Emotions*	*Intensity*
Controllo - Niente	Gioia	5	Gioia	4
Controllo - Niente	Sorpresa	7	Gioia	7
Controllo - Niente	Tristezza	4	Gioia	2
Controllo - Niente	Tristezza	4	Tristezza	2
	Intensity Mean	**5**	**Intensity Mean**	**3,75**
Congruente - Olio	Tristezza	3	Gioia	3
Congruente - Olio	Tristezza	5	Gioia	3
Congruente - Olio	Sorpresa	5	Gioia	5
	Intensity Mean	**4,33**	**Intensity Mean**	**3,67**
Incongruente - Sabbia	Tristezza	6	curiosa	5
Incongruente - Sabbia	Tristezza	3	Tristezza	3
Incongruente - Sabbia	Tristezza	5	Gioia	4
Incongruente - Sabbia	Gioia	6	Sorpresa	2
	Intensity Mean	**5**	**Intensity Mean**	**3,5**

Table 6

Clip 3

Modest variations were collected in the first question[7] (Table 7)– addressing the old man's emotions - but generally the most outlined of them was contempt, followed by sadness, fear and anger. Any substantial variation can be described from the choices.

The double congruent and double incongruous stimulation determined a decrease in the intensity judgment of -1.34 and -1. Unlike the incongruous-congruent stimulation, where we could not see any variation in the intensity (Mean = 5), the congruent-incongruous stimulation intensity incurred in an increment of +0.5. In the second question, the choice of the participant over the character emotion included, for the most (7 out of 11), "surprise". It is interesting to notice that this was the only alternative present in the double congruent stimulation. Like for the first question, in the congruent-incongruous (and reverse) stimulation the participants picked half the control's emotion statement and the other half another emotion: one of the two "outsider" emotions was always included in the double incongruous selection. The intensity about the second question determined an arousal in the two congruent-incongruous stimulation and a reduction in the double incongruous condition.

Stimulus	*Old man' emotions*	*Intensity*	*Officer's emotions*	*Intensity*
Controllo	Disprezzo	5	Sorpresa	6
Controllo	Disprezzo	5	Sorpresa	4
	Intensity Mean	**5**	**Intensity Mean**	**5**
Congruente (alluminio) + congruente (mela aspra)	Disprezzo	5	Sorpresa	6
Congruente (alluminio) + congruente (mela aspra)	Disprezzo	3	Sorpresa	5
Congruente (alluminio) + congruente (mela aspra)	Rabbia	3	Sorpresa	4
	Intensity Mean	**3,666666667**	**Intensity Mean**	**5**
Congruente (alluminio) + incongruente (mela dolce)	Disprezzo	4	Sorpresa	5
Congruente (alluminio) + incongruente (mela dolce)	Paura	7	Rabbia	6
	Intensity Mean	**5,5**	**Intensity Mean**	**5,5**
Incongruente (seta) + congruente (mela aspra)	Disprezzo	6	Paura	6
Incongruente (seta) + congruente (mela aspra)	Tristezza	4	Sorpresa	5
	Intensity Mean	**5**	**Intensity Mean**	**5,5**
Incongruente (seta) + incongruente (mela dolce)	Disprezzo	4	Rabbia	4
Incongruente (seta) + incongruente (mela dolce)	Tristezza	4	Gioia	3
	Intensity Mean	**4**	**Intensity Mean**	**3,5**

Table 7

Experience

The only neutral emotion, disbelief, was not considered in the analysis as only one emotion of this kind is not enough to find a pattern.[8]

Clip 1

For the negative emotions (Table 8) occurred an average decrease of the intensity, where the lowest was the congruent condition with a -0.375 score while the incongruous condition had -0.23.

	CONTROLLO					CONGRUENTE - BRODO					INCONGRUENTE - LIMONATA							
NEGATIVE					**MEDIE**					**MEDIE**					**MEDIE**		**CR - CT**	**I - CT**
Stress	2	0	0	3	1,25	0	2	1	5	2	2	2	0	1,33	Stress	0,75	0,08
Tristezza	4	5	6	4	4,75	3	1	5	2	2,75	5	0	4	3,00	Tristezza	-2	-1,75
Rabbia	0	0	0	2	0,5	0	1	0	2	0,75	0	0	7	2,33	Rabbia	0,25	1,83
Noia	0	0	2	4	1,5	3	1	0	0	1	3	0	0	1,00	Noia	-0,5	-0,50
Soggezione	2	1	0	4	1,75	0	2	4	3	2,25	0	3	0	1,00	Soggezione	0,5	-0,75
Vergogna	4	4	0	3	2,75	5	0	1	2	2	0	0	0	0,00	Vergogna	-0,75	-2,75
Disappunto	2	4	0	3	2,25	0	0	2	1	0,75	4	6	0	3,33	Disappunto	-1,5	1,08
Indignazione	0	1	0	4	1,25	2	1	0	1	1	5	0	6	3,67	Indignazione	-0,25	2,42
Invidia	0	0	0	0	0	0	1	0	0	0,25	0	1	0	0,33	Invidia	0,25	0,33
Ansia	1	6	0	2	2,25	0	2	2	3	1,75	0	0	0	0,00	Ansia	-0,5	-2,25
Media|medie					1,825					1,45				1,60		-0,375	-0,23

Table 8

Similarly, for positive emotions (Table 9), there was a decrease in the intensities in the congruent condition (-0.95) while for the incongruous condition the difference was inappreciable (-0.02).

	CONTROLLO					CONGRUENTE - BRODO					INCONGRUENTE - LIMONATA						
POSITIVE					**MEDIE**					**MEDIE**				**MEDIE**		**CR - CT**	**I - CT**
Serenità	2	0	3	3	2	1	0	1	1	0,75	4	3	0	2,33	Serenità	-1,25	0,33
Curiosità	5	7	3	5	5	3	2	5	4	3,5	7	5	5	5,67	Curiosità	-1,5	0,67
Amore	2	1	0	0	0,75	0	1	0	3	1	0	0	0	0,00	Amore	0,25	-0,75
Speranza	0	0	0	2	0,5	0	0	0	0	0	0	0	0	0,00	Speranza	-0,5	-0,50
Rilassamento	2	1	4	3	2,5	0	1	1	1	0,75	4	4	0	2,67	Rilassamento	-1,75	0,17
Media|medie					2,15					1,2				2,13		-0,95	-0,02

Table 9

To summarize, the emotions intensities decreased no matter the quality of the emotion in each condition, but mostly in the congruent one. The decrease for the incongruous condition was minimal if not inappreciable.

Clip 2

As in the first clip, for the negative emotions (Table 10) occurred an average decrease of the intensity, but this time the lowest was in the incongruous condition with a -0.68 score while the congruent condition had -0.35. “Sadness”, however, had an increase of respectively 1.75 and 1. It is worth to notice that the decreases were more consistent than the ones from the first clip.

	CONTROLLO					CONGRUENTE - OLIO				INCONGRUENTE - SABBIA							
NEGATIVE					**MEDIE**				**MEDIE**					**MEDIE**		**CR - CT**	**I - CT**
Stress	5	0	0	4	2,25	6	0	0	2,00	0	0	1	0	0,25	Stress	-0,25	-2
Tristezza	2	0	2	5	2,25	5	2	5	4,00	5	0	5	3	3,25	Tristezza	1,75	1
Rabbia	0	0	0	0	0	0	0	0	0,00	0	0	0	0	0	Rabbia	0,00	0
Noia	0	3	0	0	0,75	0	0	0	0,00	4	0	1	0	1,25	Noia	-0,75	0,5
Soggezione	0	0	0	3	0,75	0	2	4	2,00	0	1	0	0	0,25	Soggezione	1,25	-0,5
Vergogna	2	6	0	2	2,5	0	3	2	1,67	5	0	0	0	1,25	Vergogna	-0,83	-1,25
Disappunto	2	6	1	0	2,25	0	0	3	1,00	6	1	0	0	1,75	Disappunto	-1,25	-0,5
Indignazione	6	7	1	0	3,5	0	0	0	0,00	0	0	0	0	0	Indignazione	-3,5	-3,5
Invidia	2	0	0	0	0,5	0	4	0	1,33	0	0	1	0	0,25	Invidia	0,83	-0,25
Ansia	2	0	0	1	0,75	0	0	0	0,00	0	0	0	2	0,5	Ansia	-0,75	-0,25
Media|medie					1,55				1,20					0,88		-0,35	-0,68

Table 10

In contrast with the previous results, in the positive emotions (Table 11) there was a general increase in the scores, where the incongruous condition had the biggest with an average of 1.75 and the congruent of 1.43. “Relax”, in particular, had an increase of 3.75 average, and turned out to be the biggest average variation of the whole experiment.

	CONTROLLO					CONGRUENTE - OLIO				INCONGRUENTE - SABBIA							
POSITIVE					**MEDIE**				**MEDIE**					**MEDIE**		**CR - CT**	**I - CT**
Serenità	2	0	1	1	1	0	7	2	3,00	0	5	2	3	2,5	Serenità	2,00	1,5
Curiosità	6	0	2	2	2,5	4	7	0	3,67	6	6	3	4	4,75	Curiosità	1,17	2,25
Amore	2	0	2	1	1,25	0	5	2	2,33	2	0	4	3	2,25	Amore	1,08	1
Speranza	0	0	1	0	0,25	0	5	0	1,67	1	0	1	0	0,5	Speranza	1,42	0,25
Rilassamento	3	0	2	1	1,5	2	5	2	3,00	7	5	4	5	5,25	Rilassamento	1,50	3,75
Media|medie					1,3				2,73					3,05		1,43	1,75

Table 11

Clip 3

In the negative emotions (Table 12), 12 null variations occurred - 4 in the congruent-congruent condition, 1 in the congruent-incongruous, 3 in the incongruous-congruent, 4 in the incongruous-incongruous - and the intensities changed accordingly to the tactile stimuli condition. The variations occurred accordingly to the tactile condition: when it was congruent there was an increase in the intensities - 0.3 in the congruent-congruent, and 1.0 in the congruent-incongruous - and when it was incongruous a decrease, -0.3 in the incongruous-congruent and -0.05 in the incongruous-incongruous even though it is almost inappreciable.

	CT			CC				CI			IC			II							
NEGATIVE			**MEDIE**				**MEDIE**			**MEDIE**			**MEDIE**			**MEDIE**		**CC-CT**	**CI-CT**	**IC-CT**	**II-CT**
Stress	0	2	1	1	0	0	0,33	2	4	3	0	2	1	2	0	1	Stress	-0,67	2	0	0
Tristezza	3	3	3	6	3	0	3,00	6	5	5,5	0	5	2,5	2	3	2,5	Tristezza	0	2,5	-0,5	-0,5
Rabbia	0	0	0	0	0	0	0,00	0	2	1	0	0	0	2	0	1	Rabbia	0	1	0	1
Noia	0	2	1	7	0	3	3,33	0	1	0,5	0	0	0	2	0	1	Noia	2,33	-0,5	-1	0
Soggezione	0	0	0	0	0	4	1,33	0	4	2	0	4	2	0	0	0	Soggezione	1,33	2	2	0
Vergogna	0	0	0	0	0	0	0,00	0	2	1	0	1	0,5	0	0	0	Vergogna	0	1	0,5	0
Disappunto	0	4	2	7	2	2	3,67	0	2	1	0	1	0,5	2	0	1	Disappunto	1,67	-1	-1,5	-1
Indignazione	0	3	1,5	0	0	0	0,00	0	5	2,5	0	0	0	2	0	1	Indignazione	-1,5	1	-1,5	-0,5
Invidia	0	0	0	0	0	0	0,00	0	4	2	0	0	0	3	0	1,5	Invidia	0	2	0	1,5
Ansia	0	3	1,5	4	0	0	1,33	0	3	1,5	0	1	0,5	1	0	0,5	Ansia	-0,17	0	-1	-1
Media|medie			1				1,30			2			0,7			0,95		0,3	1	-0,3	-0,05

Table 12

In the positive emotions (Table 13), only two null variations occurred and both were in the congruent-incongruous condition. The average variations were mainly increases: the congruent-incongruous had an increase of 0.3, the incongruous-congruent of 0.6 and the incongruous-incongruous of 0.9. The only exception was the congruent-congruent where a decrease of -0.1 occurred.

	CT			CC				CI			IC			II							
POSITIVE			**MEDIE**				**MEDIE**			**MEDIE**			**MEDIE**			**MEDIE**		**CC-CT**	**CI-CT**	**IC-CT**	**II-CT**
Serenità	0	2	1	0	3	2	1,67	0	4	2	6	1	3,5	4	1	2,5	Serenità	0,67	1	2,5	1,5
Curiosità	0	5	2,5	6	2	1	3,00	3	5	4	4	3	3,5	5	4	4,5	Curiosità	0,5	1,5	1	2
Amore	3	0	1,5	0	0	0	0,00	0	1	0,5	0	1	0,5	3	2	2,5	Amore	-1,5	-1	-1	1
Speranza	0	3	1,5	0	0	0	0,00	0	3	1,5	0	0	0	0	0	0	Speranza	-1,5	0	-1,5	-1,5
Rilassamento	0	4	2	6	4	0	3,33	0	4	2	7	1	4	4	3	3,5	Rilassamento	1,33	0	2	1,5
Media|medie			1,7				1,60			2			2,3			2,6		-0,10	0,3	0,6	0,9

Table 13

Comparison between clips

Taking all the averages under the different clips and conditions there are in total 16 cases (Table 14). Between all of them we can sum the results as follows:

- 2 are higher than 1.0;
- 3 are between 0.99 and 1.8;
- 2 are between 0.79 and 0.4;
- 7 are between 0.39 and 0.1;
- 2 are between 0.09 and 0,01.

	CLIP 1 - cena			CLIP 2 - massaggi			CLIP 3 - giardino			
NEGATIVE	**CR - CT**	**I - CT**		**CR - CT**	**I - CT**		**CC-CT**	**CI-CT**	**IC-CT**	**II-CT**
Stress	0,75	0,08	Stress	-0,25	-2	Stress	-0,67	2	0	0
Tristezza	-2	-1,75	Tristezza	1,75	1	Tristezza	0	2,5	-0,5	-0,5
Rabbia	0,25	1,83	Rabbia	0,00	0	Rabbia	0	1	0	1
Noia	-0,5	-0,50	Noia	-0,75	0,5	Noia	2,33	-0,5	-1	0
Soggezione	0,5	-0,75	Soggezione	1,25	-0,5	Soggezione	1,33	2	2	0
Vergogna	-0,75	-2,75	Vergogna	-0,83	-1,25	Vergogna	0	1	0,5	0
Disappunto	-1,5	1,08	Disappunto	-1,25	-0,5	Disappunto	1,67	-1	-1,5	-1
Indignazione	-0,25	2,42	Indignazione	-3,5	-3,5	Indignazione	-1,5	1	-1,5	-0,5
Invidia	0,25	0,33	Invidia	0,83	-0,25	Invidia	0	2	0	1,5
Ansia	-0,5	-2,25	Ansia	-0,75	-0,25	Ansia	-0,17	0	-1	-1
	-0,38	-0,23		-0,35	-0,68		0,3	1	-0,3	-0,05

POSITIVE	**CR - CT**	**I - CT**		**CR - CT**	**I - CT**		**CC-CT**	**CI-CT**	**IC-CT**	**II-CT**
Serenità	-1,25	0,33	Serenità	2,00	1,5	Serenità	0,67	1	2,5	1,5
Curiosità	-1,5	0,67	Curiosità	1,17	2,25	Curiosità	0,5	1,5	1	2
Amore	0,25	-0,75	Amore	1,08	1	Amore	-1,5	-1	-1	1
Speranza	-0,5	-0,50	Speranza	1,42	0,25	Speranza	-1,5	0	-1,5	-1,5
Rilassamento	-1,75	0,17	Rilassamento	1,50	3,75	Rilassamento	1,33	0	2	1,5
	-0,95	-0,02		1,43	1,75		-0,10	0,3	0,6	0,9

Table 14

Memory

Clip 1

The first question involved the stimulated sense,[9] it asked to identify the food present in the scene. The congruent group answered correctly with a certainty of 2.5. The worst result came from the control group in correctness(0.25) and certainty(1.75). The answers from the incongruous group were better than the ones from the control group, even the security index was higher in the incongruous.

In the second question, the participants were asked to remember which object was taken from the table by the woman. All the control group was able to remember it, even if the level of certainty wasn't high (1.75). The congruent condition had the worst result (0.25)but had a better certainty (3.5) over all the other conditions.

The third question was about the position of the couple and the control group was the only one to answer correctly with a high average of certainty (6.5). The worst score for the

correctness of the answer came from the incongruous condition but their level of certainty was high (6.33) also compared to the congruent who scored more than the incongruous but had the lowest certainty score (4.75).

The fourth question demanded the shape of the tables present in the scene. All the groups were able to identify the correct shape. The incongruous condition had the highest level of confidence in the answer given (5.64) followed by the congruent (5) and the control (4).

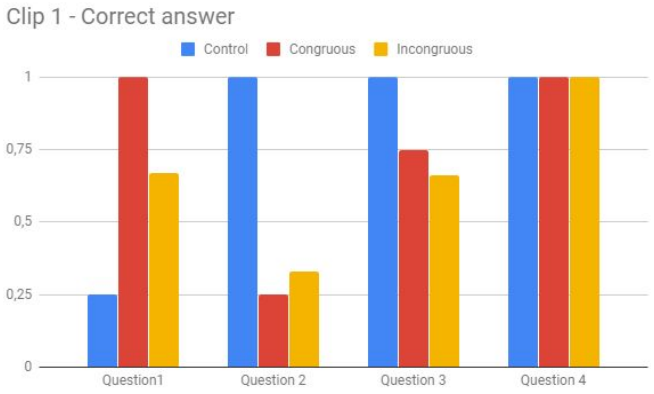

Table 15

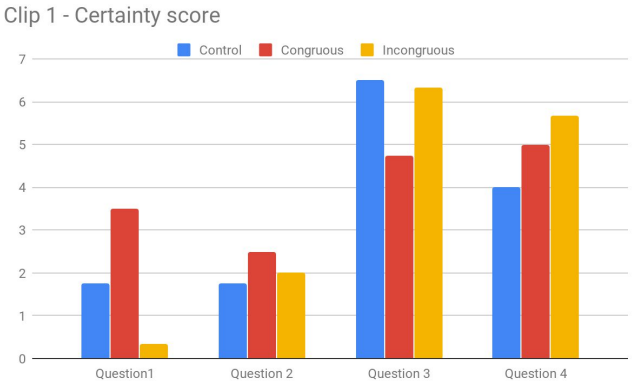

Table 16

Clip 2

The first question asked the colours of the uniform worn by the masseuse.[10] The highest correct score was performed by the congruent group while the incongruous had the lowest. The certainty score it is also the highest on the congruent (6.67) and lowest on the incongruous (4.25). The control group is always in the middle of the other two.

The second question was to remember what was the subject of the paintings in the background. Again, the highest score of the correct answer is on the congruent group, while the incongruous had the lowest, the same happened with the certainty of the answer. All the congruent group was completely sure about the answer (7) while the incongruous (2.5) was not confident at all and the control (4.5) was in the middle.

The third question asked if the masseuse had nail polish. In this case, both control and the congruent group had the right answer but the highest certainty score was from the control group (4) against the congruent one (3). The incongruous group had a lower average on the right answer and also on the certainty score (2.25)

The last question demanded where the daughter kissed the father. The best performance was from the incongruous group, while the second one was from the congruent group. While the certainty of the answer had the highest score on the congruent group (6.67) followed by the incongruous group (5.25) and then the control group (4.5)

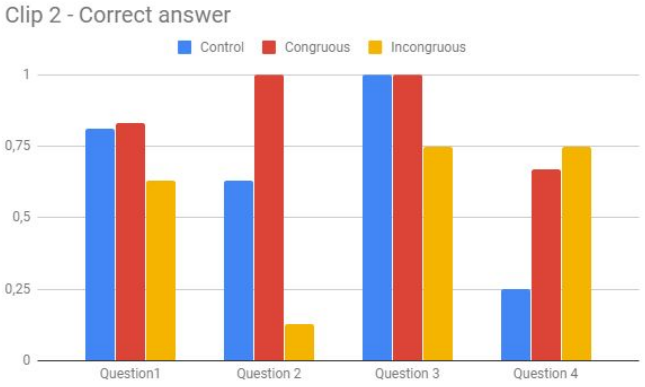

Table 17

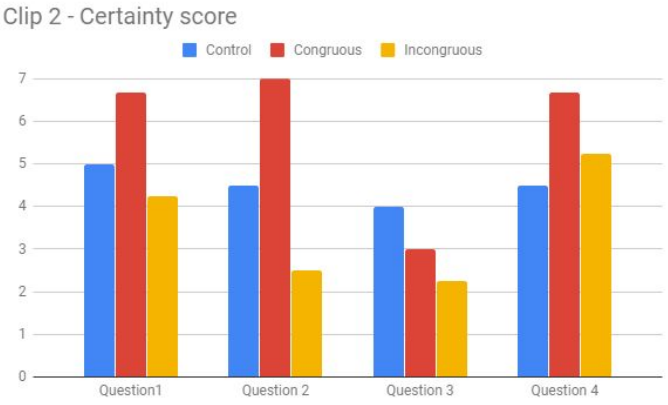

Table 18

Clip 3

The first question demanded if they recognized the presence of apples in the scene,[11] the highest right answer score was from the congruent-incongruous group (0.66) and the incongruous-congruent group (0.5) while the worse one was the incongruous-incongruous group (0). The highest certainty score was from the control (7) and incongruous-congruent group (7) while the lowest was from the incongruous-incongruous (3).

Incongruous-incongruous was the worst performance (right answer:0, confidence:3), and incongruous-congruent the best (right answer:1, confidence:7).

Both congruent (sour apple) and incongruous (sweet apple) stimuli related to the task (noticing the apples) gave the right answer, but the one with the incongruous taste on the incongruous-incongruous condition (0) was worse than the congruent-congruent (0.6).

The second question was about the color of the apples identified in the first question. We did not register the answer of the participants who did not saw the apples but this obstructed the data analysis, thus we are not going to include those answers in the global average. Still, all the people who could answer the question gave the right answer and all the certainty scores were the same (7) except for the control (5) and incongruous-congruent condition (6.5).

In the third question, we asked to recall the topic of the newspaper main page, which was connected to the tactile stimuli given. The only group who answered correctly was the control group and also half of the incongruous-congruent group. The highest certainty score was from the control (3.5) and the congruent-incongruous group (3.5) while the worst from the incongruous-incongruous (1.5). The answer from the incongruous-congruent (incongruous in the tactile condition (silk)) had a better score (005) than the congruent stimuli (0).

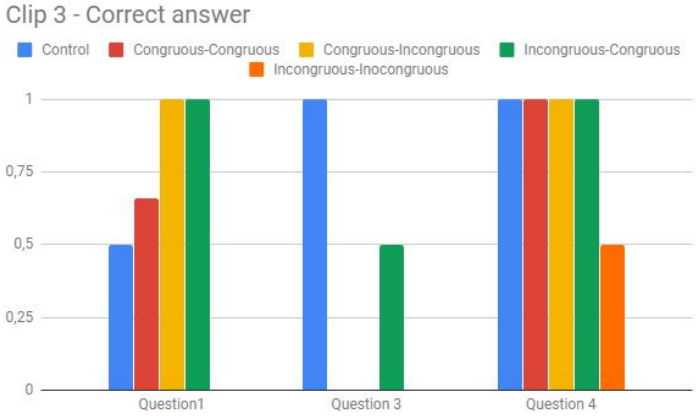

Table 19

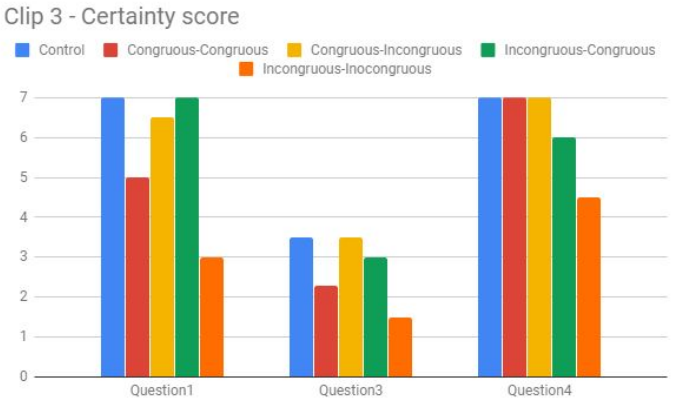

Table 20

The fourth question was about a color present in the scene. Incongruous-incongruous was the only condition that did not score the maximum in the accuracy of the answer. Control, congruent-congruent and congruent-incongruous had the best performance in certainty (7), incongruous-congruent had a lower certainty (6) while incongruous-incongruous had the worst performance in both rightness and certainty (4,5).

Global Average		
	Correct answer	Certainty
Control group	0,77	4,61
Congruous group	0,73	4,85
Incongruous group	0,47	3,38

Table 20

Comparing the average of the same group in all the clips (Table 21) we found that: the control group had the best performance in giving the right answer; the congruent group had the best confidence during the task; the incongruous group made the worst performance.

Discussion

Interpretation

Crossing the data we obtained from the previous analysis we can point out an interesting variation in the combined congruent-incongruous conditions for the third clip, therefore we can propose some assumptions: the variations over the intensity judgment in the first clip – with taste stimulation – has occurred to be positive and the same situation in the second clip occurred to be slightly negative, this happening in both the questions of each clip. Thus, we

can infer that perhaps the taste in both the incongruous and congruent type of stimulation can influence the judgment to increase; and the same situation in the tactile modality influences a little towards negative values. The third clip shows us that in those situations, where the two modalities were combined not in the same kind of stimulation (incongruous-congruent and opposite), we had a modest (+0.25) increase in three out of four conditions and an equal value on the third. Assumed that the influences of the modalities are the previously explained we can, therefore, say that the taste, in our conditions, influenced the judgment of the intensity in a higher degree than the tactile stimuli.
When it comes to the emotion matching, a little can be inferred from our results. The clip type we chose contained characters and stories in which our participants could have felt their story related to, they could have impersonated themselves, so the judgments about what could the characters have felt are not entirely objective and biased by a possible matching with the participant's past experiences. We knew this when we designed the experience and what we can suggest for the future is, in order to mitigate this phenomenon, to use clips with less relationship possible with the real world (ie. dystopian or cartoons).

Experience

The multisensorial integration did not influence the participants engagement in a significant way, except in the positive emotions in clip 2. There the two biggest intensities average variations occurred: 1.75 in the incongruous condition and 1.43 in the congruent one. It is relevant because they overcome the third biggest (-0.95 in the first clip congruent condition, positive emotions) of 0.48 which, considering the average of the results, is a consistent amount. The same effect did not happen for the negative emotions in scenes related to them (clip 1, clip 3) as in those occasions, the intensities rather decreased. In other words, it appears that the multisensorial integration in clips where are displayed positive emotions increases the feeling of those emotions. A future study should investigate this question with a more in deep this assumption.
In the third clip a consistent amount of null variations occurred and it is possible that the integration of two stimuli from different senses, instead of improving the participants' engagement, created some sort of emotional distance. We suggest that further studies should investigate this aspect.

Memory

The analysis of the memory data suggest that the stimuli given interfered with the task of memorizing the scene as we can see with the decreasing of the right answers in congruent and incongruous groups, but at the same time the stimuli connected with the question (as eating question with taste stimuli) favored the congruent condition and disadvantaged the incongruous. Even if the congruent stimuli did not really helped in the memory task we can consider that it changed the way the group felt about their answers raising the level of confidence of the coungruous group.

Another phenomenon that could be interesting to indagate is when the incongruous group had the best score into answering a question. Could it be because the type of stimuli was felt as congruent? Some more targeted question will be useful to estimate if it is accidental or due stimoli felt congruent for the particular question.
Also with more participants in the third condition could be possible to check if the incongruous-congruent and congruent-incongruous resulted better than the congruent-congruent and incongruous-incongruous conditions for casual reason or if there is a particular correlation between this outcome.

Limitations

This is a list of possible bias that we found during the experiment:

- The sample analyzed is not wide enough to consent effective deductions;
- The memory task could have influenced the interpretation task since they are one after the other;
- If the participant ate something before the experiment with a strong flavour, it could influence his perception of the given stimuli;
- We did not check if all the participants were right-handed. This could have influenced their experience when they had to drink or when they were touched;
- With one male participant we did not respect the condition of not having an experimenter of his same sex;
- The oil should have been odourless but it had a mild olive smell;
- The number of participants was not the same in each condition due to the sample number (11);
- Due to an oversight in the clip 2 survey - experience section, congruent condition - the scale was not from 0 to 7 but from 1 to 7. The results were transposed to the right scale but it was impossible to keep them perfectly as before;
- The stimuli were given by two experimenters depending on the participant's sex, so their intensity was not always the same;
- The participants could have felt in subjection during the whole experiment altering the results;
- The limited range of emotions in the interpretation and experience survey could have forced the participants in expressing what they thought and felt;
- In the experience survey the positive emotions (5) were less than the negative ones (10), this made the comparison unbalanced;
- There are some condition ranged in every experimental session that could change the participant's perception:
    - Room temperature;
    - The smell of broth in the room;

- Broth of different temperatures;
- Lemonade of different temperatures;
- Subject and experimenter different hand temperature.

Conclusion

Even though the experiment had some inaccuracies, the results confirmed our research questions in different ways. They showed that multisensory integration influences: the experience of watching a movie especially when they contain positive emotions by increasing the feelings of the participants and decreasing the negative ones, the watchers' interpretation of the characters' emotions, decreasing the memorization of visual details. The research, however, did not tell why and how this influences happen, thus it will have to be investigated in future studies.

In fact, future studies should focus either in two conditions with one sense each, or in one condition with two senses. These studies should also improve the data collecting methods, for example double-check questions, to later provide a better data analysis.

The olfactory sense should also be considered as possible sense to be investigated.

References

[↑][1] Ernst, M. O., & Bülthoff, H. H. (2004). Merging the senses into a robust percept. Trends in Cognitive Sciences, 8(4), 162–169.

[↑][2] Velasco, C., Tu, Y., & Obrist, M. (2018). Towards Multisensory Storytelling with Taste and Flavor. Proceedings of the 3rd International Workshop on Multisensory Approaches to Human-Food Interaction - MHFI'18.

[↑][3] Pink, S. (2011). Multimodality, multisensoriality and ethnographic knowing: social semiotics and the phenomenology of perception. Qualitative Research, 11(3), 261–276.

[↑][4] Matusz, P. J., Wallace, M. T., & Murray, M. M. (2017). A multisensory perspective on object memory. Neuropsychologia, 105, 243–252.

[↑][5] Clip 1: Interpretation Survey – Survey Document
[↑][6] Clip 2: Interpretation Survey – Survey Document
[↑][7] Clip 3: Interpretation Survey – Survey Document

[↑][8] Clip 1,2 and 3: Experience Survey – Survey Document

[↑][9] Clip 1: Memory Survey – Survey Document
[↑][10] Clip 2: Memory Survey – Survey Document
[↑][11] Clip 3: Memory Survey – Survey Document