Festschrift

Festschrift in honour of Clara Casco

edited by *Luca Battaglini and Sergio Roncato*

Padova UP

PADOVA UNIVERSITY PRESS

Festschrift

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The *Festschrift* series collects studies in honor of scientific personalities who have had a significant impact on research in their field.

Prima edizione 2022, Padova University Press
Titolo originale *Festschrift for Clara Casco*

Università degli Studi di Padova
via 8 Febbraio 2, Padova

www.padovauniversitypress.it
Redazione Padova University Press
Progetto grafico Padova University Press

This book has been peer reviewed

ISBN 978-88-6938-314-4

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Parte 1 Contributi Scientifici

The Extrapolation of Occluded Motion

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In 2011 I was a master student at the University of Padova and my future was nothing but fog because I had no clue about what I wanted to do with my professional life and no idea how my course in experimental psychology was going to help me figure it out. But at least I had a certitude: I did not want to become a psychotherapist.

At that time, I used to travel by train from Verona (where I lived) to Padova and vice versa. The travel time was about 1h and I spent that time reading novels. I really enjoyed that intimate moments with literature, I loved it to the point I doubtfully started wonder if I should have become a professor in schools to motivate young people to get passionate about imagination and stimulate the creative power our minds have.

Thanks to the tip of a dear friend, I met a book that enlightened my vision about my career. I read "Infinite Jest" by David Foster Wallace, an author who killed himself after struggling with depression for many years. The impact that book had on me is something that I am still not be able to describe. It simply amazed me. Its power was so strong; I dare to say that it is a really revolutionary novel. I do not want to reveal the plot here, so I will not spend many words describing it, the only thing that I am going to reveal is the presence of a film, called Infinite Jest, that is so entertaining that its viewers lose all interest in anything other than repeatedly viewing it, and thus eventually die. The idea that vision could be so powerful, even just in a novel, led me to do some personal research. I wanted to find evidence that beautiful visual images could activate brain reward circuitry, like for example, drugs do. At that time, I did not find anything related in PubMed or Google Scholar, so I decided to attend a course titled "Psicologia dei Processi Sensoriali" (Process of Sensory Perception) to increase my knowledge about human visual system. Clara was the professor. I was immediately amazed by her lessons and by the complexity of the visual system. I discovered so many things in that course, for example what is a Gabor patch and why it is so important for the visual system, the filling-in process, visual illusions, motion perception, etc… After only two Clara's lessons, I give up to my initial and perhaps naïve idea to find evidence between vision and brain reward circuitry and I decided to devote myself to study psychophysics and visual perception.

I remember very well the day I knocked at the door of her office. I was a bit anxious; I wanted to make a very good impression. When crossed the door, a friendly and gentle professor was sitting at her desk. Clara attitude made me feel relaxed since the beginning of our conversation and it has been natural for me to ask her to be my thesis supervisor. After a few questions about my motivation, she invited me to attend her lab meetings, where I familiarized with her research topics and met wonderful people like Marcello Maniglia, Giulio Contemori, Rosilari Bellacosa and Andrea Pavan. Moreover, she encouraged me to prepare an application for the Erasmus exchange program at Sussex University in England. My English was not very good and at the beginning, I was not very happy of studying abroad, but it was an easy effort to make for having the opportunity to write a thesis under Clara' supervision. Surprisingly, my Erasmus was very positive even though my proficiency in English was limited. I spent four beautiful months in Brighton where I met Professor George Mather who taught so many things such as how to program in Matlab and how to design experiment in vision science. I will always be grateful to him, the lessons he thought me and to Clara for fostering my erasmus. When I came back from England, I felt ready to start writing my thesis and running my first experiment. We decide to work on a deceivingly simple phenomenon called motion extrapolation (ME), which required so many sensory and cognitive computation to be executed.

Motion extrapolation can be defined as the operation to estimate the future position in time of an occluded moving target using exclusively the information from the visible trajectory (known dataset: space, time and speed). A very common paradigm used to study this phenomenon is called time to contact (TTC) task or prediction motion (PM) task (figure 1, here we will use "TTC task"). In this task, observers estimate the time-to-contact (TTC), defined as the time interval between the starting of occlusion and the perceived point of collision with the end of the occluder (Hecht & Savelsbergh, 2004). The occluded target never reappears (Figure 1).

Figure 1.

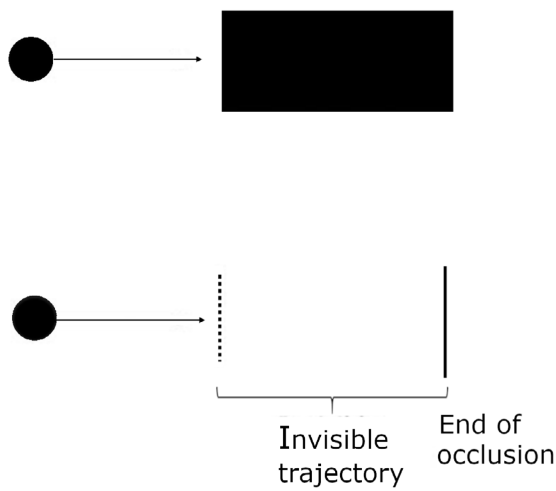

Figure 1. Illustration of a trial in a TTC task. Participants are asked to press a button when they think that the leading edge of the target reached the end of the occluder, and with an invisible occluder (lower panel), in which participants are asked to press the response button when the occluded target reaches the visible cue (black bar). In this task, the target never reappears after occlusion.

Professor Casco, wanted to study this phenomenon for several reasons that I summarize here in form of three questions:

1. Is it possible to perceive motion without physical stimulation?

2. What is the role of visual memory during the extrapolation of occluded motion?
3. What is the role of motion detectors in motion extrapolation?

During that period, professor Casco was studying vision in people with macular degeneration (MD) who have a central scotoma where vision is absent. The first question becomes especially important when considering this clinical population. For example, are MD patients able to predict the reappearance time of a moving object that crossed their scotoma? To do that, they must retain the presence of the moving stimuli even when it is no longer visible behind the blind field. We can actually expand the first question in two sub-questions:

a) In healthy participants, with an intact visual system, when the object disappear behind an occluder, is the sensation of motion preserved?

b) In people with macular degeneration, with a lesion in the central retina and (as a consequence) a cortical reorganization of the early visual cortices, when the object disappear behind the scotoma, is the sensation of motion preserved?

About question a), literature reports that the sensation of motion decreases with long occlusion duration (> 0.3sec). Burke in 1952 claimed that when the occlusion duration is short the sensation of motion during the hidden phase, namely when the target is not directly visible, is preserved and can be considered a truly perceptual phenomenon (Burke, 1952). About question b), we have only anecdotic report saying that there is still a strong sensation of motion, but we were not able to figure out (so far) a paradigm to test it in an objective way and publish results.

In the following paragraph, instead I summarize the results of my first paper published on this topic that aim to answer the second question.

Illusory speed is retained in memory during invisible motion

During my last year of master, I was finally able to write a matlab script using the psychtoolbox extension (Brainard, 1997; Pelli, 1997) and after many discussions, professor Casco and I decided that my first real experiment had to test the effect of speed illusion on motion extrapolation. Of course, speed illusion works only when the target is actually visible, so to be more specific, our experimental question was if speed illusions, seen during the visible trajectory, could modulate TTC judgments. In other words, we asked whether participants could retain in memory the illusory speed information and use it when the target was occluded to estimate the time to collision or time to contact (TTC). Therefore, we decided to have two targets with the same physical speed, but different perceived speeds. We predicted that TTC could reflect the perceived speed of the visible trajectory: shorter TTC is expected when the perceived speed is increased and longer TTC is expected when perceived speed is decreased.

We knew from previous studies that high contrast stimuli appear to move faster than low contrast stimuli (Stone & Thompson, 1992; Thompson, 1982, 2003; Thompson et al., 2006). Therefore, we run a first experiment where participants, in a 2-interval forced choice procedure, were asked to compare the speed of a high contrast disk and the speed of a low contrast one. We calculated the point of subjective equality and we found that the speed of a low contrast target had to be increased of about 4% to be perceived as fast as the speed of the high contrast one. In the second experiment we used these targets to test TTC judgments. According to our prediction, the TTC was longer with low contrast target and shorter with the high contrast target regardless the magnitude of the physical speed or the length of occluder used (Figure 2).

Figure 2.

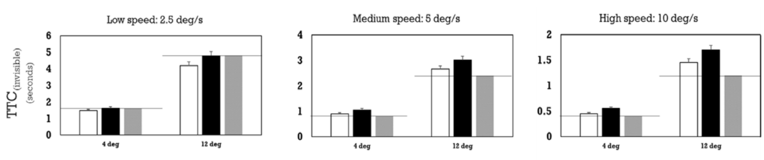

Figure 2. TTC results with targets moving at different speeds and with different occluder length. ($TTC_{invisible}$ = time interval from the starting point of the moving target to button press minus the duration of the visible trajectory).

To confirm our results, we tried to replicate the effect of visible illusory speed using a different manipulation. We modulate the perceive speed changing the targets size. We applied the so called 'transposition principle', i.e., the perceived speed of one object its modulated by its size and by the width of the visible window within which the object moves. To rephrase, the bigger the target size and the frame that delimits its motion, the slower is the perceived speed (Wallach, 1939). In a 2-interval forced choice in which participants were asked to compare the speed of a large stimulus and a small one we confirmed the 'transposition principle' effect using our stimuli, then participants performed a TTC task and we found that, although the two targets had the same physical speed, the TTC was longer with the bigger stimulus that was perceived as moving slower.

To conclude, we can say that is the *perceived speed* retained in memory and *not the physical one* that affect TTC judgments. This suggests the involvement of an early visual memory system by either a mental imagery or a higher level velocity representation that retains the sensory characteristics of visible speed. Based on these findings, we speculated that remembered speed shared processing with visual memory processes occurring at visual areas levels (Huber & Krist, 2004; Jonikaitis et al., 2009). This speculation may be supported by neuroimaging studies that revealed an activation of MT+ area during the hidden phase of the moving object (Kaas et al., 2010; Olson et al., 2004).

Finally, we acknowledge that these results do not help us to reveal the exact (cognitive or sensory) strategy used by the participants to solve a TTC task. We know that participants are affected by the perceived speed information collected during the visible trajectory, but we could not infer what are the other mechanisms involved during motion extrapolation. In literature were proposed several strategies such as: i) a tracking strategy, namely updating target spatial position thanks to the continuously shift of the visuospatial attention; ii) visual imagery, iii) the presence of a common rate controller that guides a mental stimulation at a chosen speed. However, our results allow us to reject the iiii) countdown hypothesis. Specifically, this hypothesis propose that participants can store in memory how much time is needed for the target to travel from point A to point B during the visible trajectory. Then they can estimate a priori the duration of the hidden phase from the disappearance point of the target to the point of collision indicated by the experimenter, and finally they can start a countdown as soon as the object disappears. Using this timing strategy, the duration of the hidden phase is predicted to be the same regardless the perceived speed of the target, which was not true in our experiments.

Clara and I were happy about the interesting results obtained in my first experiment, and we decided to publish them. However, before writing the scientific article, we waited a couple of months because I had to discuss my thesis and to apply for a PhD position in Padova. I graduated on October 7th, 2011. I started my PhD in Padova in January 2012, we submitted the scientific article on September 14th and it was finally published on 22nd May, 2013.

Probing the involvement of motion detectors in motion extrapolation with different forms of visual motion adaptation

Part 1

During the years of my PhD, Clara and I tried to understand the role of motion detectors during extrapolation. Some of our questions were: Are motion detectors involved during ME? What happens when we interfere with them during ME?

To answer these questions, we took advantage of motion adaptation phenomenon, i.e. a decrease over time in the responsiveness of the motion detectors. Generally, after motion adaptation, participants reported to see a static target object moving in opposite direction from the adaptor stimulus or, if the object moves in the same direction of previous adaptation, they see it as moving slower. This after effect is known as “motion after effect” (MAE).

During ME there are no physical stimulus, but motion is extrapolated behind the occluder. Can we still measure a MAE in this condition where motion is not actually visible, but extrapolated?

Gilden and colleagues in 1995 run an experiment aimed at answering this question using a TTC task. In that study, before each trial, the region corresponding to the occluder was adapted with a group of dots moving in translational motion. The results showed that when the target moved in the same (opposite) direction with respect to that of adaptation, TTC estimates were longer (shorter) (Gilden et al., 1995). The authors speculated that motion adaptation of the retinal location corresponding to the occluder may bias the response of motion detectors towards the direction of motion opposite to that of adaptation (similar to what occurs in the classical motion aftereffect, MAE). This finding apparently brings up the role of the motion detectors' activity during ME. However, some important aspects should be highlighted: the instructions provided by Gilden and colleagues (1995) directly asked participants to imagine the moving target behind the occluder, likely triggering imagery processes (in every experiments related to ME run in Clara's lab we never instructed participant to use an imagery strategy, we just asked them a TTC judgment without further instructions). The operation of ME with imagery could be different from ME without it. Moreover, they did not have a control condition with no directional or static adaptation. Would TTC have been longer after adapting in the same direction compared to a condition with no motion adaptation or with the adapting dots moving in random directions? Does adaptation really slow down (speed up) motion extrapolation or affect TTC judgments acting on different processes?

During my second year of PhD, we designed an experiment using rapid form of adaptation to further explore MAE in the TTC task and expand results found by Gilden et al. (1995). Kanai and Verstraten (2005) showed that adaptation durations and interstimulus intervals up to 320–640 ms are able to produce a bias in perception of a subsequent flickering stimulus in the opposite direction as the adaptation producing a rapid form of MAE (rMAE). We replicated Kanai and Verstaten adaptation paradigm (Kanai & Verstraten, 2005), but instead of showing a subsequent flickering stimulus, we presented a moving dot that disappeared behind an occluder and participants had to do a TTC task (Figure 3).

Surprisingly, we found that this rapid form of MAE could influence TTC. When the occluder area was adapted to congruent (same direction as the target's motion) directional motion just before the target disappeared behind it, (subsecond) adaptation produced later TTC estimates with respect to adaptation to incongruent motion (opposite direction with respect to the target's motion). As a control condition we used a texture where pixels changed their gray value every 50 ms. The phenomenal effect was similar of seeing an old detuned TV. TTC measured in this condition was lower than the TTC measured in the congruent adaptation condition, but not shorter compared to the TTC measured in the incongruent adaptation condition. These results (Figure 4) were published in a paper in 2015 (Battaglini et al., 2015). We interpreted them as a prove that that motion extrapolation, on which TTC estimates are based, depends upon the activity of the same low level motion detectors that are responsible for rMAE. At time, we were convinced that motion detectors were responsible or at least one of the most important factors involved during ME.

Figure 3.

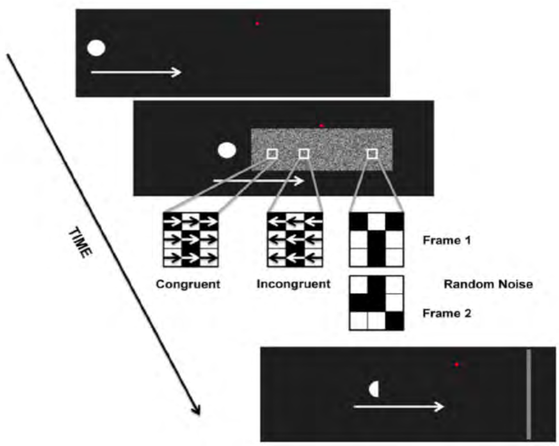

Figure 3. Illustration of a trial in Battaglini et al, (2015). A moving target travelled along a linear path at a constant speed. Then, a texture appeared for 600 ms. The texture could move congruently (same direction with respect to the target's motion) or incongruently (opposite direction with respect to the target's motion), or it could contain dynamic random noise (no directional energy). The texture was removed 120 ms before the end of the visible trajectory of the target. Finally, the participants had to press a button when they thought that the moving target reached the gray bar, indicating the end of the invisible trajectory (they were told that target maintained the same constant speed and direction behind the occluder).

Figure 4.

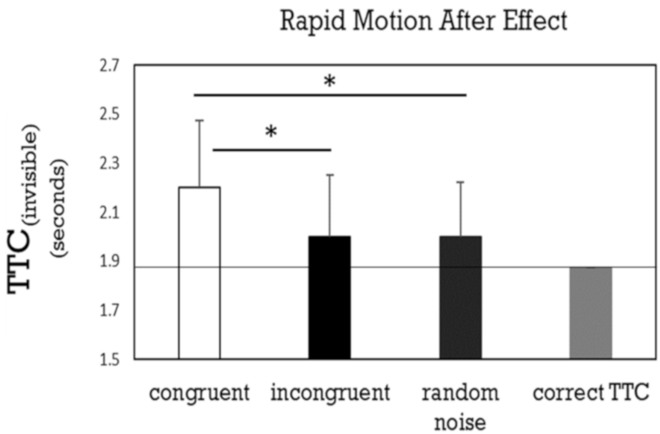

Figure 4. This Graph represents the TTCs of the invisible trajectory duration found in the experiment conducted by Battaglini et al, (2015).

Part 2

For a PhD student in experimental psychology in Padova, it is mandatory to spend a period in abroad in another lab. So, in 2014, I was a visiting PhD student at Plymouth University. Clara's suggested me a lab in London and learning how to design fMRI experiment. I admit that I was skeptical. In Padova, for a psychologist, it is very difficult to have access to the only one fMRI machine at the hospital for doing research. Moreover, I did not want to live in London. I don't like metropolis. My idea was to spend my PhD period abroad in a small city, in a lab where I could test my ideas and learning how to collect and analyse EEG data. So, in this case Clara and I had different point of view for my scientific growth, but she never stops helping me. I dare to say that the support she gave me in my early career was life-changing. I remember a summer Saturday some years ago. I applied for a post-doc position. I felt that my project on stochastic resonance in vision was weak and I emailed her. A few hours later my phone rang. I was playing football 5 a side with my team in a small tournament in Custoza (near Verona) when my phone rang. The match was about to start, but I answered the phone. Clara called me with a brilliant idea.

I told my coach that I could not play that match and I talked with her for about 1 hour. I missed a match, but thanks to that phone call I won a post-doc position.

Returning to the topic, at Plymouth University, I met Giorgio Ganis, a wonderful supervisor. We discussed a lot and he helped me to carry out my research ideas. I wanted to study the electrophysiological response in a TTC task after long motion adaptation, specifically we adapted for 60 seconds in the first trial and used a top-up adaptation of 10 seconds for subsequent trials (here I will not present EEG results because they are not relevant to answer our question number 3). Our experimental design was a bit different from differently from Gilden et al., (1995). In our experimental design we added control condition with no motion adaptation (instead of motion adaptation we presented just a static texture). In short, we tested participants in a TTC task with previous i) congruent, ii) incongruent motion adaptation, or iii) with a static texture adaptation (Figure 5).

Figure 5.

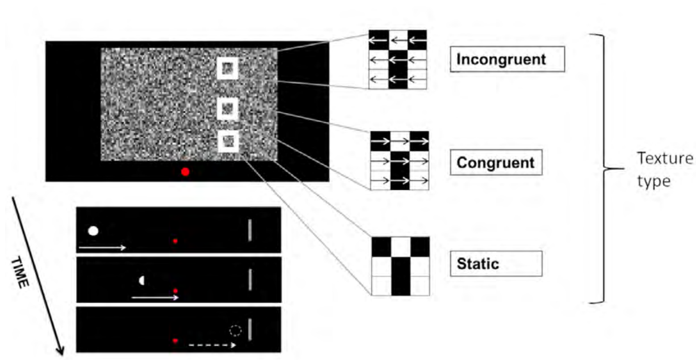

Figure 5. Illustration of a trials in the Experiment reported in Battaglini et al., (2017). Participants had to fixate the red dots and after an adaptation interval they had to perform a TTC task.

Surprisingly, the TTC was not longer in the congruent adaptation condition (Figure 6). TTC was longer in the static condition. This peculiar result questions the idea the motion detectors have a direct role during ME. We showed in several experiments that TTC judgments changes according to the direction of motion adaptation. So, motion detectors seem to be involved in a TTC task, however, the after effect produced by motion adaptation on TTC is not the same of real motion, otherwise we would have expected longer TTC in the congruent condition compared to the static one with no motion adaptation. A possible way to explain this result is to assume that dynamic adapting stimulus can change temporal perception (Kanai et al., 2006; Burr et al., 2007; Johnston et al., 2006), speeding-up the passage of time. Indeed, it has been shown that stimuli in motion are perceived to last longer (Kaneko & Murakami, 2009). Brain could estimate time based on the number of changes in an event, therefore a simple idea that explain our results can be summarized as: more changes a stimulus undergoes, the more time must have elapsed.

Figure 6.

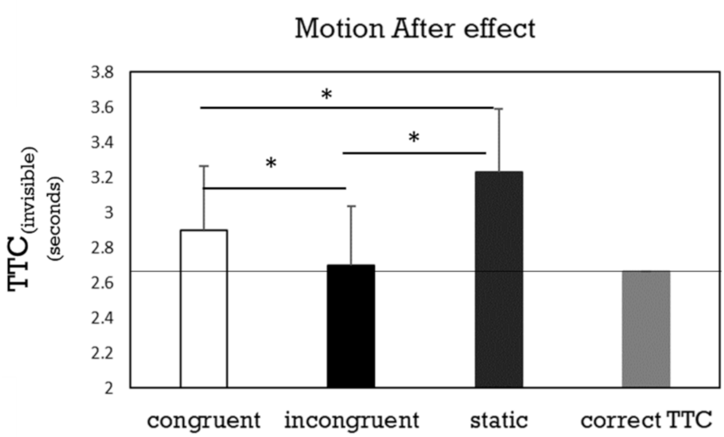

Figure 6. This Graph represents the TTCs of the invisible trajectory duration found in the experiment conducted by Battaglini et al, (2017).

Discussion

When I started my PhD, Clara and I had these questions in our minds:

1. Is it possible to perceive motion without physical stimulation?
2. What is the role of visual memory during the extrapolation of occluded motion?
3. What is the role of motion detectors in motion extrapolation?

From an experimental point of view, maybe we neglected the first one and basing on previous literature we assumed that is actually possible to perceived or at least having a motion experience even in the absence of physical stimulation, especially when the occlusion duration is short (<0.3s) (Burke, 1952). Unfortunately, we could not think a way to test in a systematic way, motion experience without physical stimulation in people with retina damage or brain damage. But I don't exclude that Clara and I will do that in a near future.

About the second question, I think we reveal compelling evidence in favor of the hypothesis that people retain in a visual memory the perceived speed (and not the actual one) of an object to estimate a TTC. Speed illusion can definitely change this judgment. This indicates the involvement of the early visual memory system that retains the sensory characteristics of visible speed during a TTC task.

We were convinced that motion detectors carry out a fundamental role during ME. We run several experiments using different form of motion adaptation and the initial results were in line with our belief. However, when using an appropriate control condition with no real motion adaptation, results do not support completely our predictions. To sum up, motion detectors seem to be involved in a TTC task, but it does not necessarily mean that they work as in real motion. Perhaps they can affect timing cognitive mechanisms. There is some evidence that showed a causal relationship between the activity of MT areas, where many motion detectors are present, and timing judgments of visual stimuli (Bueti, Bahrami & Walsh, 2008).

Probably, we need to update our framework and consider interactions among many factors that could influence the performance in a TTC task. Indeed, such deceivingly simple task required so many sensory and cognitive computation. Some of them could be: - compute the speed of a moving target, - store this speed value and use it to guide the update of target position over time during the hidden phase and - finally activate the motor program to press the button as soon as the hidden target reach the visible cue representing the end of the invisible trajectory. More specifically, we can also speculate about the strategies used by the participants to update the target position during the hidden phase: - visual imagery, shift of the visuospatial attention, -countdown, - using a module for pacing dynamic mental simulation, etc. As the reader can see, there are so many factors to consider when studying motion extrapolation.

In the studies summarized here, we studied motion extrapolation using a particular task that require a timing response and a timing judgment. However, Clara and I investigated ME using several different paradigms that I did not report here (Battaglini et al., 2013; 2015; 2016; 2017; 2018; 2019). For those interested in this topic I would refer to a review I recently published to synthesize the existing literature (Battaglini & Ghiani, 2021) and including a discussion of all the papers that I published with Clara.

Conclusion

I spent more than 11 years working in Clara's lab and what wonderful journey it has been. We worked on motion extrapolation, we studied motion perception using non-invasive brain stimulation, we designed innovative perceptual learning protocols to improve vision in patients. We co-authored more than 20 scientific articles. As I said before, the support she gave me in my early career was life-changing. Since I started my PhD, I heard so many times (PhD) students complaining about their supervisor because they were not immediately available to discuss a project or because they did not correct thesis or manuscripts within a short period of time. I have never experienced that. Clara was always and immediately available. You could stay literally for hours in her office discussing a project or correcting a manuscript. She had always to do a massive amount of things such as: lessons, write scientific projects, write scientific articles, data analysis, correct thesis, revise manuscripts, coordinate a PhD course in experimental psychology, leading a clinical lab for people with neuropsychological problems related to occipital areas (vision) etc… but she was always available to guide young students/researchers and give her the best support to them. Always.

Thank you for everything professor Clara Casco!!

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Features Segmentation and Motion Trajectories in Noise

Dr. Andrea Pavan

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I have known Prof. Casco since 2006 when I started my Ph.D. at the Department of General Psychology of the University of Padova. At the time, I got a Ph.D. scholarship for a linked doctorate with Prof. Campana, but Prof. Casco was the principal investigator of the vision group, so as soon as I learned of the scholarship I was summoned to her office. I don't remember the exact date, but I think it was early January 2006. I wasn't very well informed about the project(s) I was supposed to carry out and the first interview with Prof. Casco was quite long and difficult for me. She started asking me a lot of questions about my technical skills and knowledge of the visual system which at the time were practically zero, so I'm afraid I made her not a good impression right away. She asked me if I was able to program stimuli on the computer, but I had no idea what she was referring to and my answer was of course 'NO'. A little annoyed, she asked me to become proficient in a short time because we had to start with a project that had been pending for a long time. A few hours later we went to her vision laboratory, and she showed me the experiment she was referring to. To my amazement, I realized that it was programmed in Visual Basic. Deep inside I wondered who was still using Visual Basic in 2006, since many experiments were already programmed with the

MATLAB Psychtoolbox extension. In any case, the experiment was already programmed in Visual Basic and would have taken a long time to be converted into MATLAB, so I decided to learn the basics of the Visual Basic language enough to be able to make variations on the experiment and add certain conditions.

In this festschrift, I'd like to briefly summarize the first two experiments I carried out under Prof. Casco's supervision. Data collection was completed many years ago, but for various reasons they were only published several years later. I recall spending several hours in her office discussing the data, any conditions that needed to be investigated, and even debates about how the experiments should be conducted. The article about my first collaborative projects with Prof. Casco was only published in 2010 when I had already completed my doctorate.

The first collaborative research I'd want to examine is: "*Segmentation by single and combined features involves different contextual influences*"

Discriminability of an object from its surrounding has been widely investigated in various aspects such as orientation, spatial frequency, its direction, or retinal location. Information in the surroundings of a stimulus also has been shown to alter the response characteristics of the visual areas which could facilitate or inhibit its activation. Flanker characteristics seemingly affect the information of the stimulus in the center, for instance, while suprathreshold contrast levels of collinear flankers suppressed the response thresholds (Polat et al., 1998), near threshold collinear flankers with high contrast elements inside the classic receptive field increased the cell's response (Polat & Sagi, 1993, 1994). In other words, detection of target contrast is modulated by collinear information. Likewise, orientation discrimination was facilitated when collinear flanker orientation matched the orientation of the target stimulus as opposed to non-collinear or orthogonally oriented stimuli which implies the importance of contextual information of surrounding stimuli. However, the notion that this facilitation caused by collinear flankers is based on background or target-to-background interaction is debatable. Elements near the target or in the texture region could both be the influencing factors. For instance, orientation alignment in the far texture region could be modulating segmentation performance. In this experiment we manipulated the alignment of target and background stimuli (collinear when the orientation of the target and the background was aligned, collinear when they were misaligned). We wanted to examine whether target saliency changed based on orientation contrast alone, motion contrast alone, or orientation and motion contrast interaction. The texture presented contained 8 × 8 lines slanted 45 deg. In the grid lines were either separated by small or large distance (32 and 44 arcmin, respectively). All elements on the screen were either aligned or the target orientation deviated by 8 arcmin, with the target chosen randomly amongst the lines present in the texture. Target orientation deviation range was 0, 3, 6, 9, or 12 deg from the original 45 deg orientation when moving, or it was 0, 6, 12, 18 or 24 deg when it was static. In experiment 1a, we assessed whether orientation contrast of target facilitated segmentation discriminability performance. In experiment 1b, motion contrast was introduced along with orientation contrast to identify facilitatory affects caused by both manipulations. Experiment 1a showed that orientation discrimination was facilitated by alignment of all elements and small proximity of all elements. Experiment 1b showed that the facilitating effect of alignment is still present with less robustness when motion is introduced. Moreover, proximity of the lines resulted in smaller thresholds emphasizing the importance of spacing. To summarize, segmentation thresholds were lower when lines were aligned with smaller spacing for both moving and static stimuli. This suggests that segmentation is a process that takes element specifics into account globally. However, it was not clear why this facilitation endured when motion was introduced. It could still be the case that moving stimulus leads observers to judge the direction of orientation contrast or it could merely be based on a facilitation caused by an alignment in motion discrimination. We presented a detection and a discrimination task to better isolate the major contributing factor. If facilitation was majorly caused by orientation alignment, then we expected not to see the same magnitude of facilitation in the motion alone condition. Participants indicated whether there was a moving object on the screen. The results showed that effect of alignment was inhibitory in this case in both small and large spacing conditions. These results indicate that inhibitory effect of alignment on motion detection is present. In a third experiment we showed that misalignment of the background elements caused a reduction in thresholds meaning motion discrimination relies on target background segregation. In this series of experiments, we showed that target to background interactions, specifically in motion and orientation segmentation, result in alterations to the discrimination thresholds.

The second collaborative research I'd want to examine is: "*The effect of spatial orientation on detecting motion trajectories in noise*"

Figure-background stimulus configurations are shown to be effective on changes the behavioral performance. Some research found that discrimination performance was improved when target and the background stimuli were in orthogonal directions while other studies reported improved discrimination when orientations of both stimuli were aligned. Different results could indicate involvement of different neural processes, or they could also arise from different stimulus characteristics used in experiments. Extended trajectory is when a single element can be detected as moving when it drifts along a trajectory for more than two consecutive frames, even when it is presented among other distractor stimuli. This extended trajectory facilitates motion perception. Research also indicates that iso-motion, aligned motion, is better detectable than ortho-motion that contains elements that align perpendicularly with respect to the motion direction. Others also showed the opposite, indicating a facilitation for ortho-motion. To better identify the effect of orthogonal and extended trajectory alignment, we kept the target movement in a constant trajectory being either horizontal or vertical during 8 consecutive frames among noise. In experiment 1, iso- or ortho-motion and vertical or horizontal target locations were factored in. Participants were asked to identify the direction of motion of the target. The straightness of the target line trajectory was perturbed by jittering its spatial position from frame to frame. If the trajectory of the line was vertical the jitter was applied along the x coordinate, if the trajectory was horizontal the jitter was applied along the y coordinate. The amount of jitter was chosen between one of these values: 0, 7.6, and 15.2 arcmin. The results showed that as the jitter increased, discrimination probability decreased for iso-trajectory. Interesting finding was that ortho-trajectory was not affected by increased jitter. In a follow up experiment, we examined whether ineffectiveness of jitter increment on ortho-motion discrimination performance was due to the task presented. We measured signal line detection performance of iso- or ortho-oriented lines moving leftwards or rightwards. We also found similar results as in experiment 1 which showed that while jitter decreased detection probability for iso-oriented lines, ortho-oriented line detection probability remained unaffected. To test whether the jitter was unable to affect ortho-motion discrimination due to facilitation of orientation information on motion detection with iso-orientation as suggested by Geisler (1999) in the motion streak model, we manipulated the speed of the target. Since the motion streak model suggests that iso-oriented signals masks the motion signals as opposed to ortho-oriented signals, we expected that speed and length of the line would be important for discrimination probability. The results showed that ortho-oriented discrimination performance depended on speed whereas iso-oriented discrimination performance was dependent on both line length and speed. To further investigate iso- and ortho-motion discrimination performance, we investigated the effect of speed within a range. The results of this experiment also showed that iso-oriented discrimination probability was affected by step size whereas ortho-trajectory remained mostly unaffected. All considered, the results of our series of experiments suggested that iso- and ortho-motion discrimination may be channeled through distinct mechanisms in the striate cortex.

The two works I have discussed so far were good examples of motion perception, form perception and form-motion integration research experience I gained in Casco's lab. Under Casco's supervision I developed many important scientific skills such as computer programming, experiment planning, data collection, data analysis and manuscript writing. These research topics fascinated me so much that even nowadays my research investigates the mechanisms underlying form perception and form-motion interaction.

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The Progress of a Scientific Path

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I had the chance to work with Clara starting from 2006 and it was definitely a fruitful collaboration and one of the most fruitful in my career. Above all, I had the chance to meet and to work with a very brilliant researcher and person. The thing I like most of Clara is the stamina and dedication that puts in everything she does: working side by side with her has been a pleasure. I was 100% hearing when I first met her but I'm so glad I contaminated my CV with that of such a talented vision scientist! In fact, with Clara we found a common ground in audiovisual perception and we really provided a visually "sound" contribution to the field. Here is my scientific story with Clara.

When I teach students the path that scientific research should follow, I tell them something quite ordinary and yet shared by any scientist: you start from a theory, you generate a hypothesis, successively you test this hypothesis with an experiment. This core -that describes what is behind a single study- should be replicated over and over so that, after the first study, you extend your theory with the new findings, you generate a new hypothesis, you get some new results and so on. If this scientific loop was adopted by scientists and each study was following a preceding one in such a way, the increment of knowledge would be nice and linear and any new discovery would be a "+1" increment in knowledge in comparison to the knowledge we had before. If this is the principle science should follow, we should look at the publication of a scientist and see threads, with sequences of publications that generate one from another in a connected way, because they are concatenated. Well, when I look at my CV and my publications, nothing seems so far from reality: several publications on several scientific topics. Occasionally some issues are reprised so that one topic seems recurrent (more than others) but the whole lot seems just a complete mess. This mess extends to all my publications except for three papers, that I wrote and that seems really concatenated one to the other like the pearls of a beautiful jewel. And incidentally enough, all these three papers were written together with Clara Casco. In this brief text I will present the phenomenon we investigated and then, one after the other, in chronological succession, the three papers. When I look back at my career, I see I gave some contributions (occasionally) to this or that portion of the psychological literature. But only these three studies seem to follow by hearth the path that scientific discoveries should follow.

Where we started from

We started from an observation made by Sekuler (Sekuler and Lau (1997). These authors investigated a well-known bistable motion effect originally investigated by Metzger. And in turn, the bistable motion effect of Metzger can be observed (in a static version) in pretty much each "Introduction to Psychology" textbook you may happen to browse. One of the most depicted figures in psychology textbooks illustrates two lines crossing each other (e.g., Gray, 2002). This figure is used to explain a perceptual grouping principle, the Gestalt principle of continuity (Wertheimer, 1923): although the four segments composing the cross can be grouped in several ways, what we see is two lines crossing each other. Grouping by continuity applies not only to static figures but also to objects in motion, provided that the two objects are "passing simultaneously over the same point" (Koffka, 1935, p. 301). This is, for example, the case of the Metzger's motion display (Metzger, 1934). This motion display shows two identical objects (e.g., two discs) that move along the azimuth with uniform rectilinear motion and opposite directions: discs start their motion, overlap and stop at the other disc's starting point (see Figure 1).

Figure 1.

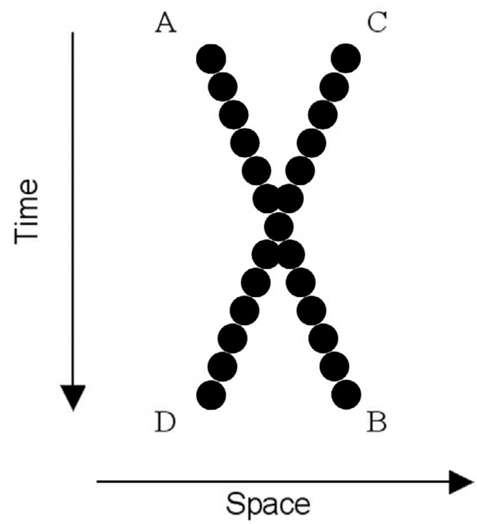

Figure 1. Two-dimensional representation of the Metzger's motion display. The objects' motion is grouped as A-B and C-D with silent displays and as A-C, C-D if a sound is played when the discs overlap. In all the experiments I made with Clara Casco, the discs' actual motion was horizontal.

This motion display served to Metzger (1934) to show that the continuity principle applies to objects' motion. Vision is here facing an "inverse optics" problem (Marr, 1982) because the objects' two-dimensional motion pattern is equally representative of two very different events in the real, three-dimensional world. In both events the observer is looking at two objects placed at different depths so that the retinal images of both have identical size. In one event, the objects start their motion, overlap (i.e., one object occludes the other), then stream past one another (respectively, trajectories A-C, C-D in Figure 1). In the other possible event, on the contrary, after the occlusion, the objects reverse their motion and return to their original starting position (respectively, trajectories A-D, C-B in Figure 1). In summary, the discs of the Metzger's display could be perceived as either bouncing off or streaming through each other. But the bistability of the display remains potential when it comes to the observers' responses. Observers, in fact, group by continuity of motion and report to perceive the streaming percept much more often than the bouncing percept (less than 0-20% of bounce responses, Berthenthal, Banton, & Bradbury, 1993, Sekuler & Sekuler, 1999; Watanabe & Shimojo, 1998; Kawabe & Miura, 2006; Kawachi & Gyoba, 2006; Remijn & Ito, 2007). At the end of the nineties, however, Sekuler, Sekuler and Lau (1997), showed that grouping by continuity can be extinguished crossmodally: it is sufficient to play a brief sound when the discs overlap to increase the number of bounce responses from 10-20% to 80-90% (Sekuler et al., 1997; Watanabe & Shimojo, 2001a, 2001b; Remijn, Ito, & Nakajima, 2004; Kawabe & Miura, 2006; Kawachi & Gyoba, 2006; Zhou, Wong, & Sekuler, 2007; Grove & Sakurai, 2009). We referred to this change in the observer response as audiovisual bounce-inducing effect (ABE).

Study 1 (Grassi and Casco 2009): attention vs crossmodal grouping

The first experiment we conducted on the ABE was somehow an *experimentum crucis* demonstrating that attention alone is insufficient to explain the phenomenon. In fact, since the ABE was observed, two alternative explanations were advanced to account for the change of the observers' response when the sound was added to the silent display. Sekuler et al. (1997) suggested that the sound alters the visual motion perception. Authors argued that, in the real world, when two objects collide an impact sound occur (Gaver, 1993a, 1993b). The temporal coincidence between sound and discs' touch increases the realism of the display in comparison with a real, elastic impact, therefore, the perception of the discs as bouncing. Alternatively, the sound may simply subtract attentional resources to vision. According to some authors, attention would integrate the discs' local motion signals, and this integration process would promote the perception of streaming when observers look at the silent display (e.g., Watanabe & Shimojo, 1998; Kawabe & Miura, 2006). In the audiovisual display, the sound is played when the discs touch one another, therefore, it subtracts attentional resources for the integration process underlying the perception of the streaming post overlap trajectory. In practice, the sound promotes the perception of bouncing because it inhibits the perception of streaming. Coherently with the attentional hypothesis, bounce responses are also predominant when brief tactile or visual stimulations are delivered simultaneously with the discs' touch (Watanabe & Shimojo, 1998; Kawabe & Miura, 2006).

We speculated on the acoustic part of the ABE. The frequency content of impact sounds varies largely whereas their intensity profile (i.e., the envelope) is invariably characterized by an abrupt change in sound pressure level followed by a gradual decay (Gaver, 1993a). Many studies investigated the perception of synthetic sounds whose envelope is similar to that of impact sounds. In literature, these sounds are called damped sounds. The perception of damped sounds has been often compared with the perception of ramped sounds (i.e., a damped sound played backward in time). Although ramped and damped sounds have identical duration, identical average sound pressure level, and identical change in sound pressure level, the first are perceived as longer (Schlauch, Ries, & DiGiovanni, 2001; Grassi & Darwin, 2006; DiGiovanni & Schlauch, 2007), louder (Stecker & Hafter, 2000) and characterized by a greater change in loudness (Neuhoff, 1998; Neuhoff, 2001) than the latter. In brief, ramped sounds are perceptually more salient than damped sounds (Grassi & Darwin, 2006). In two different experiments the discs' motion display was accompanied by either a ramped sound, a damped sound or by no sound. Because the damped resembles an impact sound more than the ramped, it should improve the realism of the bouncing-event and induce more bounce responses than the ramped. However, because the ramped is perceptually more salient than the damped, it should subtract more attentional resources and induce more bounce responses than the damped. The results of both experiments were crystal clear: only damped sounds promoted the perception of bouncing. Ramped sounds, in contrast, although attentively salient, were not raising the number of bounce responses in comparison to the no sound condition. Crossmodal grouping was likely at the origin of the ABE.

Study 2 (Grassi and Casco 2009): the role of the sound's semantics in crossmodal grouping

After we demonstrated that the ABE originates from crossmodal grouping, we investigated the role of the sound's semantics in the grouping once again by exploring the acoustic part of the ABE. In fact, the soundscape we live in is full of a variety of sounds and many of these do not result from the contact between solid objects such as in elastic impacts (i.e., bounces). Humans categorize environmental sounds according to the physical event at the origin of the sound, by listening to the differences in timbre between the sounds (Gaver, 1993a, 1993b). Gaver's (1993a) perceptual taxonomy of environmental sounds divides sounds into three categories: those resulting from the interaction of vibrating solid objects (e.g., impact sounds), those resulting from the interaction of liquids (e.g., dripping) and aerodynamic sounds (e.g., explosions). Although our capability to identify a given sound source event varies from sound to sound (Ballas, 1993; Gygi, Kidd, & Watson, 2004), listeners do not seem to confuse sounds across these three categories (Gaver, 1993a). Interestingly, the envelope of isolated impact, liquid and aerodynamic sounds is similar and it is invariably characterized by an abrupt amplitude attack followed by a gradual amplitude decay (Gaver, 1993a). In the study we conducted in 2010, we accompanied the Metzger's motion display with either an impact sound (a billiard ball striking a second billiard ball), a liquid sound (a water drop falling into water), or an aerodynamic sound (the explosion of a firework). Although the three sounds have similar envelopes (i.e., abrupt amplitude attack, gradual amplitude decay, see Figure 2), only the billiard sound was congruent with the bouncing event of solid objects and should, therefore, promote (more than the other sounds) the perception of bouncing.

The results of this study showed that the sound's semantic has a role in the ABE. In one of the conditions, the sounds were presented slightly before the overlapping point so that participants could understand the sound's content "before" the two discs overlapped. In this condition, when the sound content was congruent with that of the contact of two solid objects (e.g., a billiard sound) participants were perceiving the ABE. In contrast, when the sound was not (e.g, a liquid sound or an aerodynamic sound) participants were not showing the ABE. However, when the sound was presented in temporal coincidence with the discs' overlap, the observers were perceiving the ABE regardless of the content of the sound.

Figure 2.

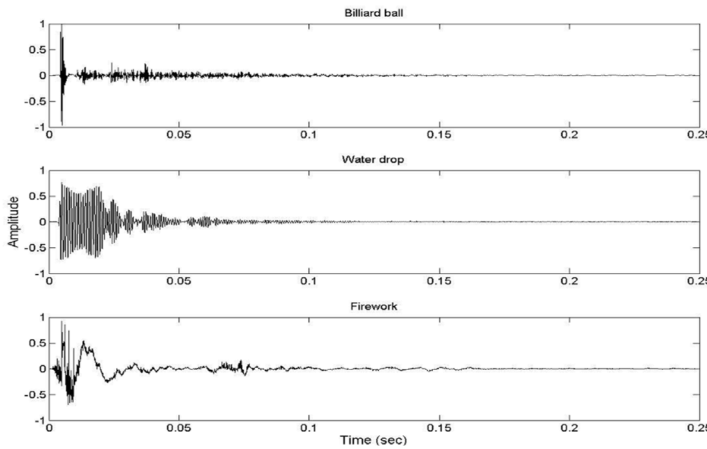

Figure 2. Waveform of the natural sounds used in the experiment equalized by root mean square amplitude.

Study 3 (Grassi and Casco 2012):

At this point we had one study supporting the crossmodal grouping (Grassi and Casco 2009) and another also supporting the grouping (Grassi and Casco 2010). The results of the second, however, left the door open for the attentional explanation as well because the sound's semantics was not able to modulate the ABE across all experimental conditions. Up to that point in the literature, the ABE had been investigated by asking participants to assert whether they perceive the discs as streaming or as bouncing. And perhaps this was a problem itself because this self-report response could embed the attentional and non-attentional components of the ABE and could never disentangle them. In brief, although the two components have been hypothesized, no empirical evidence had yet revealed the existence of the two. And our previous studies, although they supported the importance of crossmodal grouping, they both could not exclude the role of attention (better: the lack of) in the ABE. In 2012 we investigated whether and how the ABE could modulate the results of a detection task. Participants were shown displays on which discs overlapped completely during their motion (CO display, i.e., the original Metzger's display) or displays on which the discs never overlapped completely during their motion (PO displays, therefore visual displays compatible only with a physical bounce). They were asked to detect whether the display was CO or PO. In order to accomplish the task, participants will look at perceptual similarities across displays. We hypothesized that the double origin will result in a modulation of the sensitivity index (i.e., d') and the bias index (i.e., C) by the sound. If the sound subtracted the attentional resources that integrate the discs' local motion signals in the overlap region, we should expect sensitivity to be reduced when the sound was presented, in comparison to when it was not presented. Moreover, we expected to observe the action of the non-attentional component of the ABE in a modulation of the bias index C. In other words, subjects may be willing to return the same response-type for perceptually similar displays regardless of their ability to detect the overlap frame. At the end of the detection task, subjects were presented with the displays once again, but this time they were asked to report whether discs appeared as streaming or bouncing. This second block of trials was performed to assess the perceptual similarities across displays for the participants' group. The results of the experiment corroborated both predictions.

Conclusions

In these three papers I had the pleasure and the honor to work with Clara and to produce three of the best papers of my whole cv. They are all still coded today and in many cases colleagues spend good words on those works. All three studies returned solid results and the results have been reproduced several times. But the most important thing for me is the path that led to all three projects, a path that should be the everyday of science and that, in contrast, it is often so difficult to follow. Following that path was easy with such a great research companion: thank you Clara.

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A Tale of Finding One's Scientific Call

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I am grateful for the opportunity to contribute to the celebration of Professor Clara Casco's career and share my thoughts on the effects that she had on my own.

I met Professor Casco right after completing my master's degree in Psychology at the University of Padova, as I was starting my PhD in Experimental psychology in her lab. This was my first serious encounter with scientific research, as at the time I was still unsure of what my call in the world of Psychology would have been. I was still toying with the idea of taking a different path.

Neural bases of visual phenomena

Part of my PhD was devoted to the study of the mechanisms and cortical substrates of perceptual phenomena such as motion after effect and visual priming (Campana, Pavan, Maniglia & Casco, 2011), motion-induced position shift (Pavan, Cuturi, Maniglia, Casco & Campana, 2011) and audiovisual bounce inducing effect (Maniglia, Grassi, Casco & Campana, 2012) using psychophysics and non-invasive brain stimulation (TMS).

In particular, in 2011, we explored the neural substrates of a rapid form of a visual phenomenon known as motion after-effect (MAE), on which Professor Casco co-authored a highly cited review (Mather, Pavan, Campana & Casco, 2008). MAE refers to the illusory experience for which, after prolonged exposure to a stimulus moving in a certain direction, observation of the same static stimulus elicits the subjective perception of motion in the opposite direction (Mather et al., 2008). Unlike standard MAE, which requires several seconds of adaptation to the moving stimulus, rapid MAE exists in a sub-second timescale. We used repetitive transcranial magnetic stimulation (rTMS) to temporarily interfere with the integrity of targeted areas V1/V2 (early visual cortex), MT (extrastriate/middle temporal cortex) and control region Cz. Results showed that the magnitude of rapid MAE was slightly reduced for TMS delivered over MT, but maximally disrupted when TMS was delivered over V1. This result provides important understanding on the mechanisms of rapid forms of MAE, specifically the involvement of early visual areas in its generation, which had never been showed before. It additionally suggests that motion after-effects might depend on different cortical substrates depending on stimulus characteristics, depicting a complex scenario of gain control mechanisms along the visual processing pathway.

This study represented my first exploration of neural basis of perceptual phenomena using brain stimulation. In the following years I conducted more studies with a similar setup, both during my PhD in Professor Casco's lab (Maniglia et al., 2012; Campana, Maniglia & Pavan, 2013) and in my post doc years (Maniglia, Soler, Cottereau & Trotter, 2018; Battaglini, Contemori, Penzo & Maniglia, 2020). Specifically, while in Professor Casco's lab, we investigated the neural basis of the audiovisual bounce inducing effect (ABE) (Maniglia et al, 2012). The ABE is the perception of a bounce induced by a sound played at the moment of two moving objects crossing trajectories, in a motion display otherwise perceived as streaming.

At the time of this study, the neural mechanisms of the ABE were still debated. One of the hypotheses involved the subtraction of attentional resources induced by the sound (in absence of which the dominant perception would be of streaming motion), while another one suggested that such effect emerged from audiovisual cross-modal integration, further supported by evidence that bouncing-like sounds are most effective in inducing the ABE.

In this study we used offline inhibitory TMS to explore the role of the posterior parietal cortex (PPC) in the generation of the ABE. The PPC represented a promising candidate for the neural substrate of the ABE since it is thought to be involved in both attentional and binding processes.

In particular, if ABE was due to disruption of attention, then interfering with PPC during a crossing display would increase the perception of bouncing over streaming. Conversely, if ABE was due to cross-modal binding, we would expect a decrease in the perception of bouncing over streaming.

Results showed that temporarily inhibiting the activity of the right (but not the left) PPC led to a reduction of the ABE, thus pointing towards a cross-modal binding mechanism behind ABE.

This study then not only showed the causal involvement of the right PPC in the ABE, but also supported the hypothesis that cross-modal binding, rather than attention, is at the origin of the ABE.

Lateral masking and perceptual learning in peripheral vision

Most importantly for my subsequent scientific career's trajectory, in Professor Casco's lab I conducted a series of visual training studies in both healthy and clinical population, with the goal of developing rehabilitative approaches to central vision loss. This gave me the opportunity to interact with both patients and clinicians, thus expanding the scope of my research, its outreach, and the potential for contributing to establish effective interventions for clinical populations.

One of the most important studies I conducted during this time, and the cornerstone of my PhD thesis, is represented by our 2011 Plos One paper (Maniglia, Pavan, Cuturi, Campana, Sato & Casco, 2011) that describes a viable way to improve peripheral vision with perceptual learning training. We tested, for the first time, lateral masking training in peripheral vision, as a proof of concept for developing visual training to improve vision in the spare retina of patients suffering from central vision loss, such as that due to Macular degeneration (MD).

Lateral masking refers to the contrast modulation induced by flanking elements, in particular it describes a configuration in which a Gabor target is flanked by two co-aligned, high contrast Gabor patches. Training on this configuration has been successfully used to improve foveal visual abilities in clinical population (Polat, 2009). Depending on the target-to-flankers distance, the contrast modulation is either excitatory (increase in contrast sensitivity, usually observed for separations $>1.5\lambda$) or inhibitory (decrease in contrast sensitivity for separations $<1.5\lambda$). This paradigm is thought to tap into early-stage contextual mechanisms, attributed to within- and between-perceptual fields phenomena for collinear inhibition and facilitation, respectively.

Our intuition was to use perceptual learning, the sensory improvement due to systematic repetition of a visual task (Sagi, 2011), to reduce the inhibitory effects observed at short target-to-flankers separations. By reducing the inhibitory effect of flankers, we expected to find similar reduction of sensitivity for another contextual modulation effect, visual crowding, which represents one of the main obstacles in peripheral reading (Levi, 2012) thus providing a possible intervention for MD patients.

Participants were trained for 40 sessions with the training configuration (central target with co-oriented and co-aligned high contrast Gabor flankers) presented in the near periphery (4°) with separations varying from 2λ to 8λ. Results showed both collinear facilitation and inhibition, with the latter observed at distances larger than those found in the fovea (Polat & Sagi, 1993).

Crucially, training reduced collinear inhibition (Figure 1), alleviated crowding, and improved contrast sensitivity Additionally, perceptual learning training but does not increase facilitation.

This study represented, at the time, the first evidence of peripheral collinear facilitation, the first use of the lateral masking paradigm to train peripheral vision and the first time this paradigm proved successful in reducing crowding.

The evidence that a training aimed at reducing cortical inhibition would transfer to visual crowding reduction represented a promising result in developing effective interventions for MD patients, since crowding represents one of the main causes of reading difficulties in peripheral vision (Legge, Cheung, Yu, Chung, Lee & Owens, 2007).

Figure 1.

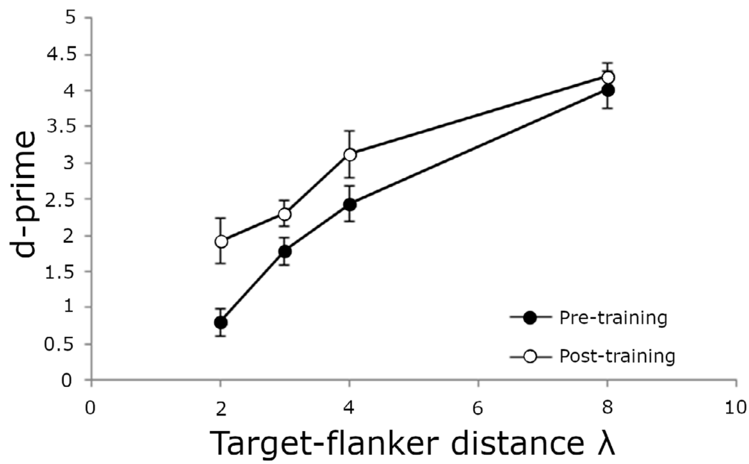

Figure 1. Contrast detection performance before and after lateral masking training for the four target-to-flankers distances trained (from Maniglia et al., 2011).

Mean d-primes as a function of the target-to-flanker distances (λ) for the target flanked by collinear flankers. Data refer to Gabor patches with a spatial frequency of 4 cpd. Filled circles are pre-training measurements, open circles are post-training measurements. Error bars ±1 SEM.

Follow up studies I conducted in Toulouse further explored mechanisms of lateral interaction, suggesting that foveal and peripheral collinear facilitation differ in terms of spatial frequency tuning and target-to-flanker separations, most likely reflecting cortical magnification in early visual cortex (Maniglia, Pavan & Trotter, 2015; Maniglia, Pavan, Aedo-Jury & Trotter, 2015).

Vision training in Macular Degeneration

Studying how the brain copes with the loss of sensory input loss can offer a privileged access to understand the functioning of the healthy brain and help develop clinical interventions in patients suffering from vision loss. In a follow up study published in 2016, we used the paradigm from the 2011 paper to train a group of MD patients. MD is one of the most common visual pathologies affecting the Western world (Wong et al., 2014), resulting in complete loss of central vision. Patients with MD are forced to use their peripheral vision to accomplish everyday tasks such as reading and recognizing faces. Most MD patients cope with loss of central vision by spontaneously adopting an eccentric fixation spot, referred to as peripheral retinal locus (PRL), as a substitute of the fovea. However, the poor sensitivity of this region renders basic everyday tasks very hard for MD patients. In this study we investigated whether perceptual learning with lateral masking would improve visual functions in the PRL of MD patients. Both MD patients and control participants were trained with two variations of the task from (Maniglia et al., 2011), specifically one condition was a flanked contrast detection training with a single stimulus interval (Yes/No) paradigm and no feedback, while the other was a two stimuli trial with a two-alternative forced choice procedure and feedback on incorrect trials. Participants underwent 24–27 training sessions in total. Both training procedures led to significant improvements in the trained task, as well as transfer of learning to visual acuity. Additionally, the two-alternative forced choice showed larger transfer and improvement in contrast sensitivity for untrained spatial frequencies, which was not observed in the single interval (Yes/No) group. Crucially, follow-up tests showed retention of learning for MD at six months, suggesting long-term neural plasticity changes in the visual cortex following training with the two-alternative forced choice paradigm.

The results show for the first time that PL with a lateral masking configuration has strong, non-invasive, and long-lasting rehabilitative potential to improve residual vision in the PRL of patients with central vision loss.

Importantly, we showed differential transfer of learning outcome depending on the paradigm used during training, namely yes-no vs 2-alternative forced choice. This is of great importance since small manipulations of stimulus or task parameters seem to lead to large differences in performance and learning (Hung & Seitz, 2014; Xiao, Zhang, Wang, Klein, Levi & Yu, 2008), thus characterizing which manipulations are effective in clinical populations carries high translational value.

Figure 2.

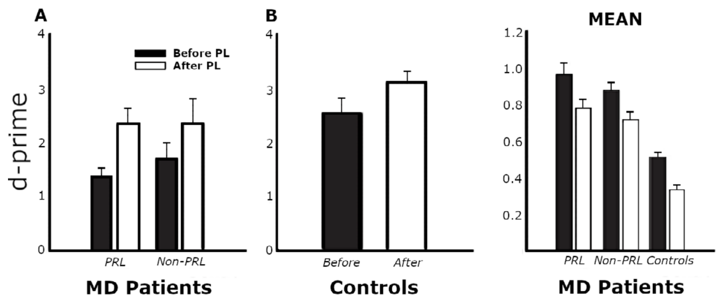

Figure 2. Left: Learning effects of lateral masking training (From Maniglia et al., 2016).

Mean d' for MD patients (A) before and after training for PRL and non-PRL. Data are pooled across spatial frequency and target-to-flankers distances. B: Mean d' for control participants before and after training, pooled over spatial frequency, retinal location and target-to-flankers distances. Error bars ±1 SEM. ***Right: Generalization effects of lateral masking training (From Maniglia et al., 2016).*** *Eccentric visual acuity (logMAR) for MD patients, separately for the two retinal locations (i.e., PRL and Non-PRL) and mean eccentric visual acuity (data pooled across the two retinal locations) for controls, before (black bars) and after training (white bars). Error bars ± SEM. (From Maniglia et al., 2016).*

After obtaining my PhD, I started a scientific journey that brought me to France (CerCo, Toulouse), California (UC Riverside) and Alabama (UAB). In all these different places, brought parts of my upbringings in Professor Casco's lab, in particular during my Toulouse years, I delved deeper into visual training development for patients suffering from MD.

In my experience at UC Riverside and UAB, I further explored mechanisms of plasticity associated with perception and eye movements in patients and in healthy participants trained with simulated scotoma, a successful framework for the study of compensatory strategies following central vision loss.

My work with Professor Casco has left an enduring impact on the trajectory of my research, so that now, at UC Riverside, where I am a Research Associate, I can see traces of what started more than 10 years ago in the labs and offices of the Department of General Psychology in Padova.

Indeed, the NIH R21 grant I was recently awarded, and that will fund my next few years of research, has without a doubt its seeds in the many scientific discussions we had in her office Via Venezia 8 over the course of three intense and extremely formative years.

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The role of the Magnocellular and Parvocellular Pathway in Dyslexia

Dr. Ambra Ciavarelli, Neuropsicologa e Psicoterapeuta

As a young student, I was troubling in finding a direction to my studies, as my interest was divided between research and clinical practice. First answers came by Professor Clara Casco, during the second semester of the first year of my master's degree in Cognitive Neuroscience and Clinical Neuropsychology. During the *Developmental and Aging brain* course, her scientific scrupulousness intermingled with her passionate knowledge and, of course, her unique style, truly bewitched me. Her lessons introduced me to the concept of brain plasticity and the possible clinical outcomes of a good evidence-based practice. Particularly, she guided my interests towards Perceptual Learning (PL), helping me exploring how low-level perceptual processes sustain and influence higher perceptual (Casco et al., 2015; Maniglia et al., 2016; Casco et al., 2018) or even cognitive processes, such as reading (Contemori et al., 2019; Ciavarelli et al., 2021). Despite my final dissertation regarded a psychophysics study supervised by Professor Casco, I started to realize that my working interest was directed toward clinical practice rather than pure scientific research. Professor Casco was able to foresee my clinical attitude with patients and guided my professional growth into the visual rehabilitation field. Indeed, her methodological rigour showed me the intrinsic link between research and evidence-based rehabilitation protocols. Thence, during my years of Postgraduate formation, I had the opportunity to work with Professor Casco research and Clinical staff at the NeuroVis.U.S. Lab, within the clinical services of the University of Padua.

Professor Casco gradually grew my clinical autonomy, trusting my insights but always directing my sight upon the methodological and research aspects of the clinical practice. During the years at the NeuroVis.U.S., we applied different PL protocols for the rehabilitation of different visual deficit, for example, amblyopia (Barollo et al., 2017), macular degeneration (MD) (Maniglia et al., 2016), hemianopia (Casco et al., 2018). One of the first conference I attended as participant, regarded indeed the clinical procedures for Hemianopia rehabilitation. I still remember the great happiness with whom I accepted the invitation of Professor Casco to the Conference in which she would have illustrated the NeuroVis.U.S. Neuro Restoration Training, a PL protocol for the rehabilitation of Hemianopia. Our road trip to Parma is one of my warmest memories with Professor Casco. Along with the scientific and working esteem, that was the first time I experimented an even greater human complicity and affection, along with the confirmation of her remarkable class. Indeed, she has been able to be accompanied by car, from the garage to the hotel front door (150 m), without even asking for it. I am still wondering how to get such a treatment with a simple glance.

Throughout my Postgraduate years, my neuropsychological background has always been nurtured by Professor Casco, who deliberately involved me in those research project focusing on the link between low-level visual processes and higher-level cognitive processes. This collaboration brought her best fruit within the field of research upon Developmental Dyslexia and visual processes.

Our first research work in this field, published in 2019 (Contemori et al., 2019), started from the consideration of Skottun's review (2000), who observed how many pieces of evidence are not compatible with the predictions of a magnocellular deficit hypothesis of dyslexia. Indeed, this theory suggests that low-level problems in visuo-temporal information processing could arise from an inefficient processing within the magnocellular stream (Stein, 2001; Stein, Talcott, & Walsh, 2000), as showed by higher contrast thresholds for the detection and the discrimination of dynamic stimuli (Martin & Lovegrove, 1987; Cornelissen, Richardson, Mason, Fowler & Stein, 1995; Ridder, Borsting, & Banton, 2001; Slaghuis & Ryan, 1999; Hill & Lovegrove, 1993; Eden et al., 1996; Demb, Boynton, Best, & Heeger, 1998; Pammer & Wheatley, 2001; Buchholz & McKone, 2004; Ben-Yehudah, Sackett, Malchi-Ginzberg, & Ahissar, 2001; Laycock, Crewther, & Crewther, 2012). There is indeed evidence that dyslexic individuals perform worse in these conditions than age-matched controls (Buchholz & McKone, 2004; Demb et al., 1998; Ben-Yehudah et al., 2001), but most results show a reduced sensitivity in a wider range of spatio-temporal conditions. Thence, as a research group we were willing to explore the involvement of both the Magnocellular and the Parvocellular systems within the aberrant low level visual process in dyslexic individual. Alternative to the Magnocellular hypothesis, we argued that dyslexia may be associated with a reduction of the facilitation that normal readers present for stimuli relying on low-level magno-parvo co-activation (Kulikowski & Tolhurst, 1973; Breitmeyer & Julesz, 1975; Tolhurst, 1975), relative to stimuli eliciting pure magno activation, in other words, stimuli of low SF (lower than 1 c/deg), very high TF (15–30 Hz) and very low contrast (Merigan & Maunsell, 1990; Merigan, Byrne, & Maunsell, 1991). We speculated that any advantage in contrast sensitivity, produced by either increasing spatial frequency (from 0.5 to 4 c/deg) of static stimuli or decreasing stimuli temporal frequency (from 30 to 10 Hz) would be ascribed to the differential responses of both systems. To test this hypothesis, we recruited nineteen children with Developmental dyslexia (DD) (7 females), average age 10.8 (SD 0.5), nineteen chronological-aged matched controls (AC) (14 females), average age 11.3 (SD 1.9) and a group of nineteen adults (8 females), average age 21.5 (SD 1.36). All participants performed a contrast detection task with either flickering or static stimuli and contrast threshold were measured. In the experiment with flickering stimuli, participants viewed a counterphase flickering Gabors of of 0.5 c/deg SF that could be either at 30 Hz, a TF that allows selective magnocellular activation, or at 10 Hz, a TF good enough to allow magno and parvo co-activation. In the other experiment, the static Gabor had a SF of 0.5 and 4 c/deg. By choosing these parameters, we wanted to ensure the involvement of the parvocellular processing, that is dominant for the high SF stimulus (4 c/deg), while a coexisting magno-parvo activity is more likely to be present while detecting a low SF stimulus (0.5 c/deg). Stimulus duration was always 250.

To assess the relative contribution of the magnocellular and parvocellular pathways, we normalized contrast threshold for the target stimulus (X), with respect to that obtained in the baseline stimulus

(Y). The log10(X/Y) computation may return a result not significantly different from 0, indicating that contrast sensitivity was no different in the X condition with respect to the baseline Y. Conversely, a threshold modulation minor or major than 0 value indicates either an advantage in contrast sensitivity (lower contrast thresholds in the X condition) or a disadvantage (higher contrast thresholds in the X condition) with respect to the baseline (Y). In other word, threshold modulation was an index of how varying spatio-temporal parameters of the target (X) resulted into a change of the magno-parvo activation in favor of either system.

In this first research project, we found a decrease in contrast thresholds for the 0.5 c/deg Gabor in the control group, either static or flickering at 10 Hz, as well as for a static Gabor of 4 c/deg. On the other hand, conversely to the predictions of the magnocellular hypothesis, dyslexic observers showed no deficit in the unmixed magnocellular response (flickering Gabors at 30 Hz). Also, differently from controls, they do not show any advantage when the relative weight between magnocellular and parvocellular inputs was thrown off balance in favour of the parvocellular system. Indeed, we measured a negative modulation index for controls with both a 0.5 c/deg Gabor, either static or flickering at 10 Hz, and for a static Gabor of medium SF (4 c/deg), while in dyslexic observers no facilitation effect was found for the .5 c/deg grating (static or at 10 Hz) and the advantage was reduced for the static stimulus of 4 c/deg (the threshold modulation index either did not differ from 0 in the .5 c/deg Gabor, or it was less negative in the 4 c/deg Gabor). In summary, our results indicate that DD participants, unlike controls, do not benefit from a change in the systems balance in favor of parvocellular inputs exhibiting a greater drawback when the balance is changed in favour of the M system. These first evidence pushed us into exploring the idea that in dyslexia, rather than the contribution of one system, is the relative contribution of the M and P systems in visual processing to be perturbed. This aberrant M-P coactivity may result into aberrant visual consequences in word processing, both within the parafovea and the fovea during fixation, as fast feedforward low-frequency representations of spatial structures results from the coexisting responses of two systems (Kulikowski & Tolhurst, 1973; Breitmeyer & Julesz, 1975; Tolhurst, 1975).

We indeed continued our investigation process, publishing a year later new evidence in the field of dyslexia and low-level visual process (Ciavarelli et al., 2021), well conscious that the understanding of low-level visual processes in dyslexia may guide us into the development of a new low-level visually based training. Evidence in the field already supported our idea that several stages of the reading process involve parvo-magno coactivation. This is true either at lower-level word processing (Nassi & Callaway, 2009; Sawatari & Callaway, 1996; Sincich & Horton, 2005), as well as during higher level processing of words, as suggested by Laycock and Crewther in 2008 (Laycock & Crewther 2008). Indeed, without an appropriate coactivation of M and P systems, early combined coding of visual features (P-based) and their position (M-based) would be affected, and the contribution of dorsal-to-ventral feedback would process word units less effectively (Boden & Giaschi, 2007; Laycock & Crewther, 2008).

To further clarify whether dyslexia could be associated to aberrant co-activation between M-P systems, we started reasoning on “visual stress” complained by dyslexic individuals during reading. The most debated cause of these phenomena regards inefficient saccadic suppression (Casile, Victor, & Rucci, 2019; Goolkasian & King, 1990; Ross, Burr, & Morrone, 1996; Skottun & Parke, 1999; Volkmann, Riggs, White, & Moore, 1978), that may be associated also the to the inhibition of retinal motion, eliciting M-driven visual transient response (Bair & O’Keefe, 1998). Inefficient M-M inhibition would produce “visual stress”. Also, visual image during fixation is not static. Hence, during the fixation of letters or words the visual inputs relevant for reading must be perceptually segregated from the retinal motion that arises from foveating micro-saccades and drifts (Johnston, Pitchford, Roach, & Ledgeway, 2017a, 2017b). If dyslexic individuals lack of efficient motion-form segregation, they may experience “visual stress”. Thence, we speculated that a lateral masking task might be suitable to evaluate motion-form segregation in dyslexic individuals. The efficiency of motion-form segregation may be inferred by the reduction of unmasking effects that static high spatial frequency flankers have on moving target.

We started our reasoning from two well-known notions:

1. Response to motion can be reduced by the lateral masking from a surround activating the same system (Tadin, Lappin, Gilroy, & Blake, 2003),

2. The coactivation of the parvo system prevents the suppressive effect of the surround (Casco, Battaglini, Bossi, Porracin, & Pavan, 2015; Churan, Richard, & Pack, 2009).

Also, Churan et al. (2009) demonstrated that the suppressive effect on the target is associated with a magno-magno inhibition mechanism, as it is an abrupt stimulus presentation to result into the suppressive effect. Moreover, Casco and colleagues in 2015 demonstrated that suppression is strong with flankers' SF lower or equal to the target's one, but it was absent with flankers' spatial frequency 2 octave higher than target's one. These results supported the idea that lateral masking of motion due to the transient onset of the flankers can be disrupted if the parvocellular system is coactivated: if target and flankers both stimulate the M system, the abrupt transient stimulus onset provokes lateral masking, whilst it does not occur target and flankers stimulate different systems. We than conjectured that both the inhibitory effects due to M-M inhibition and the disinhibitory effects due to M-P coactivation, could be involved during reading. They in fact guarantee perceptual stability by suppressing retinal motion during saccades and fixations (Boden & Giaschi, 2007).

Therefore, starting from the idea that the lateral or surrounding masking of motion can be defeated if a parvocellular coactivation is present and reasoning upon the fact that some low-level reading mechanisms might be involved in lateral masking tasks, we explored magno-magno inhibition and magno-parvo cooperation in individual affected by Developmental Dyslexia (DDs). A group of DDs' and Typical Development (TD) individuals performed several lateral masking tasks in which the relative involvement of the two systems was varied by varying the masks' SF (Casco et al., 2015) and the stimulus duration (Churan et al., 2009). Since whit high SF and long durations, the activation is perturbed in favour of the Parvocellular system, inefficient M-M inhibition in DDs would be reflected in higher contrast threshold elevation with short duration and low spatial frequency flankers, whereas inefficient M-P coactivation response in DDs would instead lead to a greater lateral masking in DDs than TDs, with long stimulus duration (reduced transient response) and high SF flankers (M-P co-activation). Moreover, we correlated the visual performance in tasks involving M-M inhibition or M-P coactivation to reading scores at standardized tests, to confirm the association between these visual mechanisms and reading processes. 50 (27+23) observers were recruited for the study. 27 of them had diagnosis of Developmental Dyslexia (average age 11.1, SD 1.44, 11 Females and 18 males). 23 of them were Typically Developed controls (TD) chronological-aged matched (14 Females and 9 males, average age 11.8, SD 1). In the main experiment, DDs and TDs performed a motion discrimination task, of a .5 c/deg Gabor target moving at 16 deg/sec, either isolated or flanked by static Gabors with a SF of .125, .5 or 2 c/deg. To have comparable magnitude values of threshold, before running the experiment we decided that when the participants' motion-direction contrast threshold for the isolated target is higher than .2 (Michelson contrast), the block will be repeated with a target duration of 0.75 ms, a duration consequently kept in the following blocks. This procedure resulted into two samples: one tested with stimuli duration of 50ms (short duration) and one stimulus duration of 75ms (long duration). Of course, a stimulus duration of 50 ms promotes a transient response appropriate for surround suppression (Churan, Khawaja, Tsui, & Pack, 2008; Tadin & Lappin, 2005; Tadin et al., 2003). In the control experiment, observers were asked to perform a contrast detection task with static target, either isolated or flanked.

We found no difference in contrast thresholds between DDs and TDs for the target optimally stimulating the M system (isolated .5 c/deg Gabor; speed: 16 deg/sec; short duration). Interested in the effect of the different flankers' SF, we normalized individual contrast thresholds for flanked motion-direction discrimination, by the thresholds measured with the isolated target. This ratio, expressed in log units, was an index of the Threshold elevation by the flankers. Threshold elevation can be >, < or = than 0, indicating suppression, facilitation, or no effect by the flankers.

Our findings showed that DDs performed likewise TDs with either a static target or an isolated moving target of low spatial frequency, thus suggesting efficient feedforward Magnocellular (M) and Parvocellular (P) processing. Also, DDs showed similar contrast thresholds to TDs in the M-M inhibition condition. Conversely, DDs did not recover from lateral masking in the M-P coactivation condition. In addition, their performance in this condition negatively correlated with non-words accuracy, supporting the suggestion that an inefficient Magno-Parvo coactivation may possibly be associated to both higher visual suppression and reduced perceptual stability during reading.

That is, the expected release of lateral suppression of a dynamic target optimal for M stimulation, by the flankers appropriate to stimulate the P system (P-M facilitatory co-activation), does not occur in DDs.

These results pinpointed the possibility that suppressive lateral interactions, a form of low-level crowding, may subserve higher level crowding in reading (Maniglia et al., 2011). We thence started to speculate that the reduction of suppressive lateral interactions, obtained both by reducing M-M suppression or by increasing P-M facilitation, may improve the reading process. If suppression is not reduced by either mechanism, the conscious coarse representation of the word formed at the highest level of dorsal processing (Hochstein and Ahissar, 2002) may also comprise elements that are not part of the actual target word and consequently affect the ventral system visual analysis, where the formation of word representation is sustained by the raw representation of the retroactive dorso-ventral (M-P) pathway (Laycock & Crewther, 2008; Ciavarelli et al., 2021). Reducing M-M inhibition by PL may improve reading speed and reduce reading errors.

Based on these premises, we took a new rehabilitative approach for the training of DD, based on the evidence that perceptual learning (PL) can improve higher-level visual processing through the potentiation of lower-level circuits (Fahle and Poggio, 2002). Specifically, we relied on the evidence that PL modulates contrast thresholds in lateral masking conditions, selectively reducing suppressive lateral interactions for the target (Casco et al., 2015). As I am writing this script, Professor Casco is working with me and Arianna Andreani on a paper presenting a study aimed at demonstrating that suppressive phenomena at early level of visual cortical processing (i.e.: lateral masking of motion) may be associated to a consequent impairment in higher level visual analysis involved in reading and that reduction of suppressive phenomena by PL may improve reading skills.

Our building block for identifying the appropriate protocol was the evidence, in adults' participants, that a PL lateral interaction modulation resulted into a reduction of the suppressive or lateral masking effect of flankers on target (Casco et al., 2015). We predicted that a visually based – lateral interaction protocol might produce benefits beyond the usual age range. We believe that proving the efficacy of a possible training protocols that can reduce peripheral suppression to enhance higher level central visual analysis of a written text has clinical advantages. If these results would be replicated in children together with a transfer on reading skills in DDs, these benefits obtained beyond the usual age range, would show that such a PL training would be a potential rehabilitative tool for pre-adolescence dyslexic children.

By assessing motion suppression through a lateral masking of motion paradigm in dyslexic children, and by training lateral interaction through PL, we expect:

1. A modulation of suppressive effect of flankers that may rely upon flankers' SF. (Casco et al, 2015; Ciavarelli et al., 2021). Indeed, both studies showed M-M suppression when flankers' spatial frequency was equal, or one octave lower that of the target. This suppression was released or cancelled when flankers' spatial frequencies was 2 octaves higher than the target. Only normal readers show facilitation with a stimulus duration of 75 ms and flankers of high spatial frequency (two conditions optimal for P activation), indicating that both flankers' SF and stimulus duration play a role in threshold modulation. A corollary question is therefore whether PL can improve P-M facilitation in DDs.

2. A PL effect measured in terms of reduction of suppression, that is distinctly from the effect on isolated target threshold. The specific effect of the training on lateral interaction can be assessed by measuring contrast detection thresholds before and after the training in the condition of the single target (no flankers). When no effect on contrast thresholds is measured in this condition, while an effect on lateral interaction is observed in the flanker conditions, it is possible to suggest that PL might result into a modulation of lateral interaction within the Magno system or between Magno and Parvo systems interaction. In other words, we expect a modulation of the lateral interactions rather than a reduction of contrast thresholds for the target in the trained conditions (with flankers), namely, we expect to measure a selective reduction of lateral masking for the trained conditions (Casco et al. 2015).

3. Absence of transfer to contrast detection tasks on stimuli not involving lateral interactions between dynamic target and static flankers

4. A transfer effect of PL training on reading skills, in terms of increasing reading speed and accuracy and to the neural plasticity

studies in adolescence and preadolescence samples (Benedek et al. 2003; Berlucchi e Buchtel, 2009).

Although the paper is still in progress and control data are still required, it seems that PL training resulted into an improvement of reading skills, opening an important debate about the clinical implication for rehabilitation in the field.

I am fully aware that my psychophysical theoretical background is lacking some fundamental and my methodological approach to science might be rather disorganised. As she once summarised in a comment to my thesis: "*Ambra, science is not poetry, I am sorry, but you cannot state that!*". Nonetheless, my deepest gratitude is still for her ability to always value my strengths, supporting my decision to pursue the clinical practice, considering me as a whole person, rather than an employee.

There is one last thing I need to state. Professor Casco dedication to her work is a priceless gemstone. I do not know if she realised that during my last year of Post Graduate work, she has been the Professor I always looked for as I knew that she takes her job with a serious passion. She appreciates initiative, I know. Nonetheless, she is always available to discuss even tenth times the same topic, until you truly understand it. Most of the time the process was sustained by a Socratic discussion, sometimes accompanied by a glass of white wine, in the best occasions, with the most beautiful Portello's spot behind.

With profound affection and respect,

Ambra.

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Keeping Up with Clara Casco, an Ever Moving Target

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Note: To view the movies, open the camera app on your iPhone, frame the QR code and tap the notification bar at the top of the screen. For an Android phone, download a QR reader of your choice and follow its instructions.

We start with some history of the work that I, the first author here, Stuart Anstis, have done with Clara Casco. My research productivity, always erratic, took a great leap forward when Clara Casco came to visit me in California in 2006. I had 50 good reasons to ask Clara to write a paper on motion perception with me, in particular, she had published at least 50 papers on motion perception, my favourite area.

Visitors who are escaping the damp miseries of England often exclaim at the beautiful South California weather. Not Clara. The climate in Padua is every bit as good as in Del Mar. And coming from a university that was founded in 1222 she was hardly overawed by a stripling college such as UCSD that did not even exist until 1960. However, she did enjoy staying with me in my little white house in Del Mar overlooking the Pacific. I found that instead of sitting and gazing out of the window at the ocean as I usually do, I was dragged along by Clara's energy and accomplished ten times as much with her as I had ever done without her. Every day her partner Luciano would phone her from Italy for long, fond, expensive international phone calls. Her head may have been in California but her heart was in Italy. And my, how hard she worked. And when I subsequently visited the beautiful city of Padova I was pleased to find that I was visiting Clara and Luciano. I have to admit that our 2006 effort is possibly the only paper that Clara has ever published that contains no actual data. But it is still one of my favorite papers; perhaps because Clara has always been one of my favorite collaborators. Our mental powers overlapped; arguably her two worst papers are my two best ones.

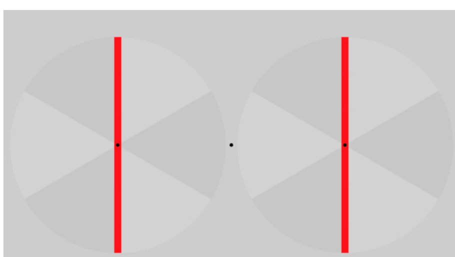
We published the work we did during her stay in the *Journal of Vision* (Anstis & Casco, 2006). In the article we reported how a moving background completely reorganized the perceived motion of two tests (bluebottle flies in this case), changing the perceived size of circular paths of motion or even making them look like linear movement.

Three long years went by and Clara and I published a second article, called 'Perceived shrinkage of motion paths', together with two of her students, Michele Sinico and Giulia Parovel (Sinico, Parovel, Anstis, & Casco, 2009). Michele and Giulia had laboured long hours to do most of the work involved. This again involved motion paths, both linear and rotary where we noticed (as with the bluebottle flies) that the motion paths seemed shortened or shrunken compared to their physical extent. At slow speeds, observers were relatively accurate, but, as the speed increased, the size of the path was progressively underestimated, by up to 35%. This underestimation imposed little memory load and did not require tracking.

Conversations with the two students, Michele and Giulia, confirmed my suspicions that Clara was an excellent supervisor, guide and friend to them both. They have subsequently gone on to successful scientific careers at the University of Siena (Giulia) and the University IUAV of Venice (Michele). I cannot think of a nicer trio of universities – Padova, Siena and Venice! Giulia has not lost her imaginative Italian flair – I see that in 2021 she wrote a paper on "How to make a square amusing" ...

Since these projects with Clara, I have continued to work on these two topics (A) path shortening, and (B) induced position shift with Patrick Cavanagh, another great admirer of Clara's work. Patrick and I have concentrated our efforts on two novel phenomena that are both related to the well-known flash lag effect (Nijhawan, 1994, 2002, 2008), in which a short vertical line moves at constant speed from left to right. When a spot is flashed up exactly on the line in mid trajectory, the spot appears to lag behind the line.

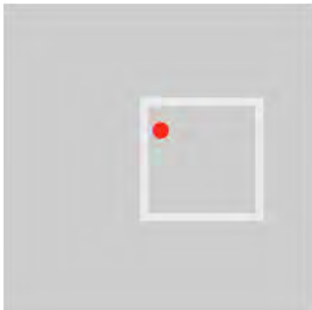
We called our first effect the "flash grab" illusion. A sectored disc rotates back-and-forth through (say) 90° and each time the motion reverses in direction a vertical line is flashed on the diameter of the disc. (Movie #1) So the line flashes at 12 o'clock just as the disc starts to rotate clockwise, and it is perceptually dragged clockwise to about 1 o'clock. When the disc reverses and starts going back counterclockwise the line flashes again and is now dragged counterclockwise to about 11 o'clock. We also showed that the travel of the sectors themselves also comes up short, linking the effect directly to the earlier path shortening (Sinico et al 2009). For some reason, the flash at the moment of reversal is grabbed by the sector edge and is seen at the (path shortened) location of the edge



Movie 1. Flash Grab (Cavanagh & Anstis, 2013). Scan the QR code on right to view movie. The sectored disks when they appear rotate back and forth and on each reversal of direction, a pair of vertical colored lines appear briefly. Although the lines are vertical and parallel, they may appear tilted in (red) and then out (green) at each subsequent appearance. The moving backgrounds will fade in and out in to show that the lines are vertical and parallel. Fixate the central dot for best effect. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie%201.%20FlashGrab.m4v

We call our second phenomenon a “frame effect”. A square outline frame moves back and forth horizontally, and two spots are flashed inside the square each time the motion reverses. The spots are both at the same location, but they appear as two widely separated spots, one to the left and to the right of their true physical location. In fact, it appears that the spots’ separation is judged not in absolute terms but in terms of their positions relative to the moving square when they flash, as if the square were stationary. Yet observers can clearly see the movement of the square. This phenomenon is related to the effect that the moving background had on our bugs (Anstis & Casco 2006) and earlier in the displays of Duncker (1929) and Wallach (1959), Wallach et al. (1978). Our new stimulus uses flashing tests and that turns out to be critical. In previous work on the effect of a moving frame, the tests were continuous: our bluebottle flies (Anstis & Casco, 2006) moved up and down sinusoidally, Wallach et al.’s (1978) target moved along a vertical straight line, and Duncker’s (1929) targets were stationary. With Duncker’s continuously visible target, the moving frame only produces a small, reversed motion in the target (induced motion) when the frame’s motion is so slow it is near the motion threshold (Nakayama & Tyler 1978). But the illusory displacement induced into our flashed targets was more than *ten times* greater than that reported by Duncker. We speculate that a continuously visible target accumulates steady information about its true physical position that countermands any position or motion induction from the moving background.

We divide the recent work that we report here into two sections. The section headed “Paths shortening” was inspired by Sinico, Parovel, Casco and Anstis (2009) and the section headed “Induced position” was inspired by our bluebottle paper (Anstis & Casco 2006).



Movie 2. The frame effect (Özkan etal., 2021). Scan the QR code on right to view movie. The two red disks are vertically aligned and flash at the reversals of the frame's motion. Although aligned, they appear separated by almost the displacement of the frame. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie 2. Frame Effect.m4v.

Further details can be found in Cavanagh and Anstis (2013), Anstis and Cavanagh (2017), Özkan, Anstis, 't Hart, and Cavanagh (2021), Cavanagh et al. (2022), and Takao, Anstis, Watanabe, and Cavanagh (2022).

A. Path shortening

Sinico et al. (2009) found that the path of a moving spot often looks much shorter than it really is. For instance, three spots arranged at the corners of an imaginary equilateral triangle were made to move bodily along a common circular path. Observers adjusted the diameter of these circular paths until they judged that the three circles just touched in the middle. In fact they underestimated the dots' trajectories and selected circular paths that overlapped considerably. We now extend this work by showing similar path shortening for various kinds of motion -- not only for spots moving in a straight line or around a circle, but also for lines rotating back and forth around their centres. We found in all cases that the motion paths looked shorter than they really were.

We attribute this path shortening to a travelling averaging-window, producing a perceived location that is the average of the test positions over a short period of time. Figure 1 shows that time-averaging will round the corners off a triangular motion path and reduce its perceived amplitude. Over a certain range, the longer the integration time the more the perceptual amplitude is compressed.

Figure 1.

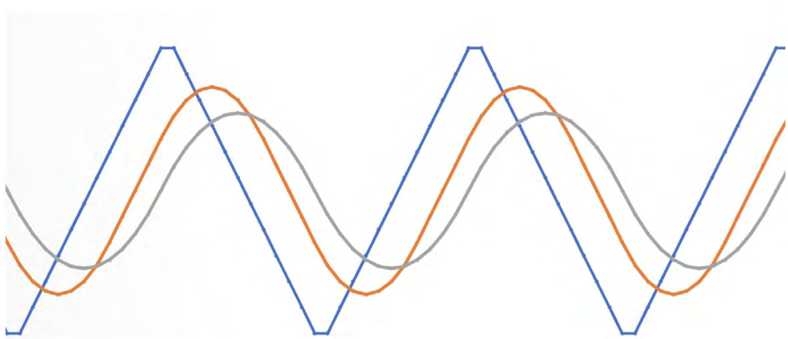


Figure 1. *Blue triangular wave shows the path of a spot that moves back and forth. Time-averaging windows, shown as orange and grey vertical bars, compress this wave into the orange and grey sinewaves, of reduced amplitude. (Bars are drawn here with sharp edges but would actually be Gaussian windows).*

Here are three examples of motion paths that looked short: 1. A dot moving back and forth horizontally, 2. A line that rotated back and forth through 180°, 3. Dots arranged around the edge of a rotating circle.

1. Apparent shortening of linear motion. A small spot moved back and forth at constant speed along a linear motion path at rates ranging from 0.3Hz to 3Hz, like the blue triangular wave in Figure 1. The motion path was either 3°, 4° or 6° in length, and observers adjusted the length of a static horizontal line to match the apparent path thanks. Results were pooled for the three path lengths, and the ratios of the perceived to the actual path lengths are plotted in Figure 2. It can be seen that the perceived amplitude fell off linearly with increasing speeds.

Figure 2.

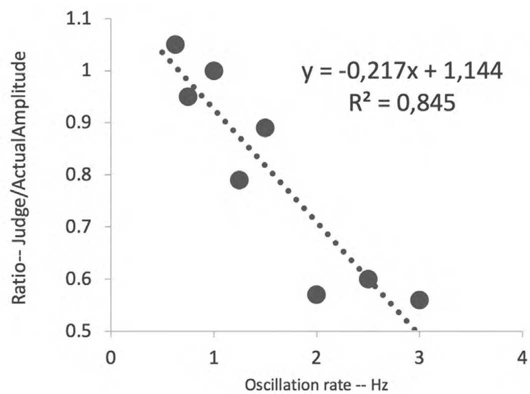


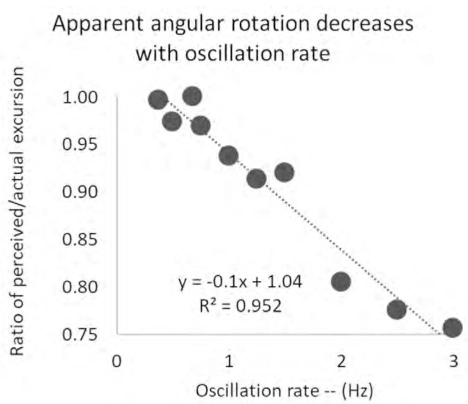
Figure 2. Apparent shortening of rotation. *We rotated a black vertical rod back and forth through 180° (half a revolution) at frequencies ranging from 0.375 to 3 Hz (1 Hz = 1 back & forth rotation) Observers adjusted a nearby pair of rods forming an X, setting their X-angle to a perceptual match with the perceived amplitude of rotation (which was always 180° but looked progressively smaller with increasing speed).*

Movie #3 shows typical matches made, and results are graphed in Figure 3. This graph implies a physiological integrating time of **182 ms.**

Figure 3.

Movie 3. Path shortening (Sinico et al., 2009). Scan the QR code on right to view movie. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie 3. PathShortDemoLoop.m4v. Top row shows a line oscillating through 180° at different speeds. Bottom row shows typical settings made to match the line's apparent excursions, which decrease as speed increases.

Figure 3. *Results from Movie 3. Perceived excursions of oscillating line decrease as speed increases (path shortening)*



2. Apparent shortening of spot rotations. Movie **4** shows the apparent shortening of four spot paths. The spots do move through 90° so that their virtual paths just touch, but they seem not to. So we set up 3, 4, 6 or 8 spots equally spaced around a circle. These spots rotated back and forth, and five observers adjusted the amplitude of the motion until the paths of adjacent spots just seemed to touch. Result: they made the arc-shaped motion paths 30° -- 40° too long so that they overlapped, as shown in Figure 4. The spots' perceived motion paths had been shortened by the motion and the observers had to compensate by making the physical path longer.

Figure 4.

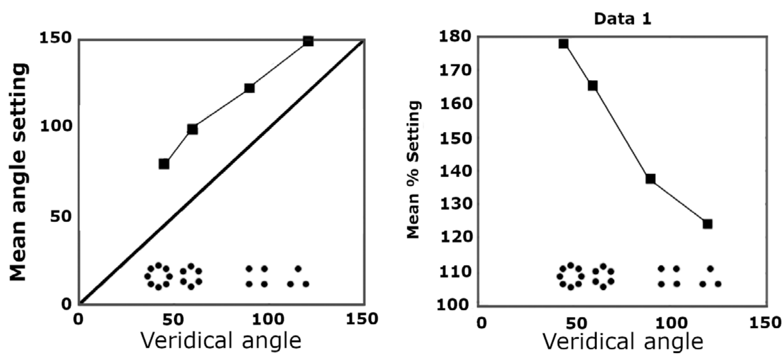
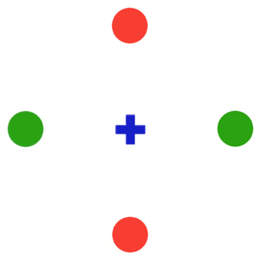


Figure 4. *(Left), Settings were 30° -- 40° above veridical in order to look correct. Vertical lines show ±1 SE: most were smaller than the plotting symbols. (Right), Same data replotted as percentages shows that path lengths were set to 120% -- 180% of correct length. Veridical settings would be along the 100% horizontal line at the bottom of graph.*

Results. Results are plotted in Figure 4, in ***left*** as actual settings and in ***right*** as a percentage of the actual rotation. Veridical settings would always lie at 100%, but most observers' settings lay between 120% and 180%. This means that the observers set the physical rotation to 20% to 80% greater than the correct setting to look correct – a strong apparent shortening of the rotary path length in every condition. This path shortening is similar to the motion path shrinkage described by Sinico et al (2009)



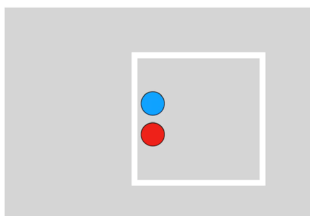
Movie 4. Path shortening. Scan the QR code on right to view movie. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie 4. PathShorten90.m4v. Paths of adjacent spots actually touch but look shorter than they are.

B. Induced position.

In 2006 Clara and I found that moving backgrounds could alter the perceived motions of small moving objects. These observations confirm and extend the pioneering work of Duncker (1929) and Wallach (1959), Wallach et al. (1978). Their stationary targets seemed to move opposite to the moving backgrounds over a short path, while our moving targets combined their real motions with the illusory induced motion. Since then Patrick Cavanagh and I have found that an induced path of displacement can be increased up to *tenfold* if the targets are simply flashed instead of being visible all the time (Özkan et al 2021). When the targets are continuously visible they show almost no visible displacement. Duncker (1929) used such stationary targets, into which the moving frame induced only a very small opposite motion; and the frame's motion needed to be so slow that it approached the motion threshold.

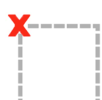
In **Movie 5,** a moving square frame initially contains two stationary spots, which may appear to move slightly against the moving square (Duncker's 1929 induced motion effect). However, when these same two spots start flashing in alternation at the moments when the frame reverses its direction, they appear to be separated by almost the same distance as the square's displacement (Cavanagh et al., 2022). We speculate that in the first case (equivalent to Duncker's stimulus), the continuous presence of a stationary target accumulates evidence as to its actual position, which resists induction from the moving frame. This suggests that the position of the flashed target is judged not in coordinates of the stationary world but in frame coordinates, as though the frame were perceived as stationary, even though paradoxically the motion of the frame is seen quite clearly (Özkan et al 2021). These demonstrations are available here:

https://cavlab.net/Demos/FrameEffect/



Movie 5. Frame effect with static vs flashed probes. Scan the QR code on right to view movie. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie 5. StaticVSFlash.m4v. While the frame moves the static spots look stationary (no induced movement), but the flashed spots appear to jump back and forth through almost the entire distance of the square's displacement.

We also tested the effects of this induced position shift on young versus old observers. Here we found that the illusory displacement of a flashing target looked very real – to the extent that many older observers found it virtually impossible to point at such targets. We set up a target that kept flashing in the same position while a square moved around continuously behind it. The spot appeared to jump to locations in the opposite direction to the square, and we asked observers to move the cursor onto the target. We first invited young volunteers from the UCSD student body and then visited a local retirement home in search of older volunteers. My student Kaylee Ryan was far more successful at recruiting their help than I was. Seeing me reminded them that they were old, and seeing her reminded them that they used to be young. We found that all of those under 65, and half of those older than 65, could do this task without any trouble within a few seconds. But the other half of the over -65s (including SA but not PC) had great difficulty with this apparently trivial task. They would move the cursor towards the general area of the target and then flail the mouse around almost at random until they got lucky and landed on the target. This could take them anything from one to two minutes. Somehow the moving background disrupted their sense of the target's position as can be seen in the data of Figure 5 (Anstis 2019a). We never really understood this age-related disability, but we did show that our observers' difficulty was perceptual, not a motor problem with controlling the mouse, since they found it surprisingly easy to hit a target that was actually jumping around in real motion. It was only the illusory displacement that caused the trouble.



Movie 6. Four flash frame effect for localizing probes. Scan the QR code on right to view movie. Go to this address if you are unable to use the QR code: https://cavlab.net/Demos/Clara/Movie 6. SquareForOldies.m4v. The red and blue crosses are in the same place, but the moving dashed square confuses many people over 65 and they are unable to move a cursor on to the crosses.

I spent many happy times with Clara, first in my home city of San Diego and then in her home city of Padua. I am in awe of a university whose alumni include the scientists Copernicus, Galileo Galilei, Vesalius and William Harvey, the physician John Caius (co-founder of Gonville & Caius College, Cambridge), the Elizabethan spymaster Sir Francis Walsingham, the composer Giuseppe Tartini, the poet Torquato Tasso, the great Casanova himself, and Clara Casco. Overall, some of my best times in science have been spent with Clara Casco. So I dedicate this chapter to her, my favorite Professoressa and collaborator.

Figure 5.

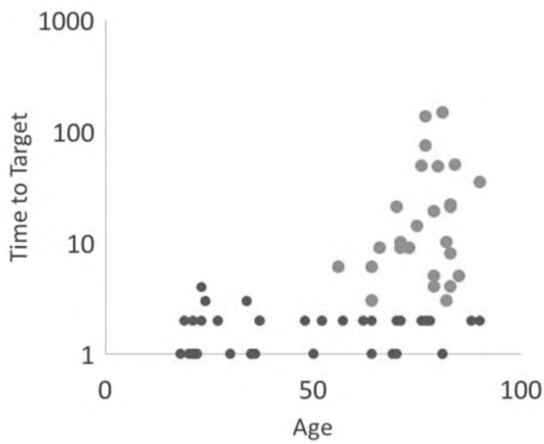


Figure 5*. Time-to-target (s) versus age. Note that 61% of all seniors over 65 years were slow to hit the target (light gray datum points). (Anstis 2019)*

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When Research Meets the Clinic: The Neuro Visual Training

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It was March 23, 2012, when an article was published in the local daily newspaper in Padua reporting, "The first eye-gym at the University of Padua is called Neuro.Vis.Us. A place where you can correct, thanks to ad hoc exercises, a long series of vision defects". The article continued with a quote from Professor Clara Casco: "Vision disorders are often cortical in origin. In other words, vision begins but does not end in the retina," hence the mission of Neuro.Vis.Us: "to improve vision through neurovisual training." (Il mattino di Padova, 2012). It was around that time when I approached the upstart Neuro.Vis.Us laboratory for what was my pre-graduate internship. I can retrace the origin of my interest in vision science to my participation in the lab meetings held by Professor Casco. Professor Casco was genuinely excited about the newly formed Neuro.Vis.Us. and the possibility of applying her decades of experience in psychophysical and psychophysiological studies to visual rehabilitation. Her passion became my passion in later years, and Professor Casco thus became my mentor. It was for my graduate thesis that I joined the lab. I was involved in a study about the relationship between visual and cognitive functions in the elderly. The study aimed to answer two experimental questions. On the one hand, we wanted to test whether it was possible to improve visual abilities in the elderly through neurovisual training. On the other hand, we wanted to test whether the eventual visual improvement would transfer to higher-level functions to the point of affecting the cognitive sphere. We were only able to confirm the first of our two hypotheses, replicating results already found in the literature (Maniglia et al., 2011; Polat, 2009). The visual training paradigm was based on a lateral masking task, at the time I did not know the relevance it would have had in my later studies. I remember the day I presented the results at Professor Casco's lab meeting, the interest and curiosity shown by the group members soon swept away my initial apprehension. Since then, I have continued to learn a lot from Professor Casco and the other members of the Neuro.Vis.Us lab. In this manuscript, I will present a narrative review of selected translational work by Professor Casco that focuses on the lateral masking paradigm and its application in visual rehabilitation. This overview includes mostly (but not only) studies in which I directly participated under Professor Casco's supervision during my master's and doctoral studies.

The Lateral Masking Paradigm

Lateral masking is a paradigm used to study lateral interactions at the early stages of visual processing. The task typically consists in detecting a low-contrast Gabor flanked by one or more high-contrast Gabor patches (Casco et al., 2014; Polat et al., 2004; Tanaka & Sagi, 1998). This paradigm is one of those most widely used to study contextual influences in vision. In the years immediately before the Neuro.Vis.Us lab foundation, Professor Casco had published several studies on the influence of context on texture segmentation, and so the study of lateral interactions was a natural extension of her pre-existing research line (Casco et al., 2011; Grieco et al., 2006, 2007; Robol et al., 2011, 2012, 2013). Moreover, evidence was accumulating about the potential clinical application of the lateral masking paradigm (Polat, 2009; Tan & Fong, 2008). It was therefore a logical step for the Neuro.Vis.Us lab to explore the use of this task for visual rehabilitation. Thanks to the previous electrophysiological and behavioral studies (Chen et al., 2001; Polat et al., 1998; Zenger & Sagi, 1996), the lateral masking task offered the advantage of accurate predictions and hypotheses. The typical experimental manipulation in this paradigm is to vary the distance between the collinear flanks and the central target. The distance is calculated in multiples of the wavelength of the target Gabor, that is, the lambda (λ). The effect of the flankers is evaluated in comparison to a baseline condition. The baseline condition consists of a contrast threshold measured with the target in isolation, or more frequently with orthogonal flankers. When collinear flankers are placed at a medium target-to-flankers distance (i.e., 3 – 6λ), contrast detection is enhanced (Polat & Sagi, 1993, 1994a, 1994b). When collinear flankers are placed at a short target-to-flankers distance (i.e., 1 – 2λ), contrast detection is dampened. At a large target-to-flankers distance (i.e., > 10λ), there is no effect on contrast detection (Tanaka & Sagi, 1998).

Figure 1.

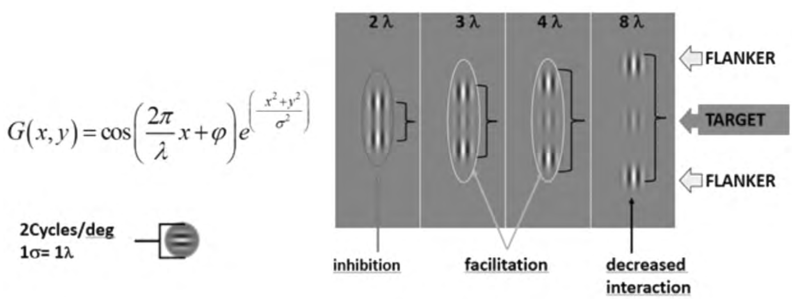

Figure 1. The image shows the Gabor stimulus type used in the lateral masking paradigms and the variation in effect (inhibition vs facilitation) at different target-flanker distances.

The mechanism behind this dissociation is not entirely understood, but there is a general agreement between neurophysiological and psychophysical data (Grinvald et al., 1994; Polat & Norcia, 1996). Lower contrast detection thresholds than the orthogonal are generally considered to be a sign of facilitation between perceptive fields that are contiguous in space and that code for the same visual feature. On the other hand, the increase in contrast threshold is interpreted as a within perceptive field inhibition (Adini et al., 1997; Polat & Sagi, 1993; Zenger & Sagi, 1996). The spatial range of the lateral interactions is also known to increase with eccentricity, in agreement with what is known about the cortical magnification and the spatial integration in the periphery (Maniglia et al., 2015). The assumption behind Neuro.Vis.Us lateral masking training was that extensive training can "reshape" the range and the strength of collinear lateral interactions (Polat, 2009; Tan & Fong, 2008). At the time, this field was not much explored, and it was not yet known to what extent training with the lateral masking paradigm would transfer to higher-level visual functions. Professor Casco will attempt to answer this question through a series of studies conducted at the Neuro.Vis.Us laboratory. The clinical application of the lateral masking paradigm was inexorably intertwined with the much broader literature related to perceptual learning. Perceptual learning consists of a practice-dependent improvement in a task that may persist for months; it is specific to the type of stimulus, the type of task, the eye, the retinal location, the spatial frequency, the orientation, and many other properties of the training stimuli (Fahle, 2005; Fiorentini & Berardi, 1980; Gilbert et al., 2001). The specificity of PL contrasts starkly with the clinical purpose, for which high levels of generalization and retention are desirable. Previous PL studies supported the idea that the degree of acquisition, generalization, and retention of PL are strongly related to task difficulty and the number of repetitions (Ahissar & Hochstein, 1997; Liu et al., 2012). Training with many repetitions and with stimuli that were very difficult to discriminate (high similarity between them) are produced high but very specific learning (Harris et al., 2012) while training with shorter sessions (Aberg et al., 2009; Karni & Sagi, 1993) and coarse discrimination (Jeter et al., 2009) led to superficial learning but higher transfer. A paradox occurred: PL required prolonged training with highly selective stimuli, but at the same time this prevented generalization to untrained visual tasks. How to solve the paradox? One possibility was that training could transfer to very similar tasks sharing the same processing network. This prediction was part of the reweighting hypothesis, postulating that learning occurs by changing the strength of neural connections specific for a given task between the early processing stage and a decision unit (Dosher et al., 2013; Dosher & Lu, 1998). On the other hand, the Reverse Hierarchy Theory (RHT) postulated that top-down modulation during training influences the signal-to-noise ratio and after repetition drives learning by triggering a structural change in the whole system. As we shall see later, Professor Casco's response was to preserve stimulus selectivity for low-level properties while maximizing the top-down control aspects of training to unlock transfer.

From theory to practice

The first published work by Professor Casco's group with the lateral masking paradigm was based on the hypothesis that by training a low-level neural network, all the higher-level modules that readout from the trained one will benefit from the training allowing for a cascade of improvements (Maniglia et al., 2011). The research was published in PLoS ONE and had as first author Dr. Marcello Maniglia, at the time a doctoral student at the Department of General Psychology in Padova. The research had been conducted on healthy subjects with normal vision, in collaboration with Dr. Giovanni Sato, head of the Padua Low Vision Rehabilitation Center. This was a clear indication of the long-term applied intent of the project. The training paradigm already encapsulates many of the constituent features of what would later become the Neuro Visual Training (NVT) protocol at the Neuro.Vis.Us. laboratory. In this study, they investigated whether lateral masking in the near periphery transferred to two untrained, higher-level tasks (visual acuity and crowding). They confirmed previous results on the differential effect between short and long target-flanker separations, but at distances greater than those found in the fovea. This was an initial indication that the range of lateral interactions scales with eccentricity. Most importantly, they found that the training regimen reduced the suppressive effect of the flankers at 2λ, improved contrast sensitivity, and reduced crowding. It should be noted, however, that in this study they did not find an improvement in visual acuity. Nevertheless, the results laid a solid foundation for the clinical application of the training. Indeed, the finding that training reduced the critical space necessary to discriminate objects in clutter, a.k.a. the visual crowding. The first implication was that learning a low-level task transferred to a higher-level one. The second implication was that it was possible with one inexpensive training to improve contrast sensitivity and crowding altogether. These findings were relevant to all those clinical populations such as amblyopia or macular degeneration, where reduced contrast sensitivity is associated with heavy visual crowding.

The development of the Neuro Visual Training (NVT)

The 2011 study demonstrated the potential of a lateral masking-based training paradigm in improving contrast sensitivity and critical spacing in the parafovea of healthy subjects. The next step was to optimize the paradigm to achieve the maximum possible transfer in patients. Apart from the type of stimuli and the number of repetitions, other factors can influence the success of the training. For example, the participant's commitment (Lee et al., 2012) and attention during training also play an important role (Lee et al., 2012; Paffen et al., 2008; Roelfsema et al., 2010; Tsushima & Watanabe, 2009). Thus, optimizing PL for clinical purposes requires training the entire chain from the coding of the stimulus to the decision-making process and even beyond, up to the backward feedback propagation to the coding areas. In principle, this might be possible by combining a stimulus tuned according to low-level perceptual features of the system, with an engaging task that can ensure a consistent top-down modulation (Ahissar & Hochstein, 1997; Wang et al., 2010). This was what Professor Casco and her colleagues tried in their second work with the lateral masking paradigm. Compared with the first study, some changes were made to the training paradigm. First, instead of a constant stimulus procedure, an adaptive threshold procedure was used. Second, feedback was introduced to inform the participant on each trial about the accuracy of the given response. The adaptive procedure consisted of a 1up-3down Levitt staircase regulated by a temporal 2-alternatives forced-choice (Levitt, 1971). Thanks to the staircase, the difficulty of the task could be individually adjusted, resulting in a challenging but not frustrating task. Also, the total number of trials was reduced along with the duration of each training block. It should be noted that the temporal 2-AFC involves more elaborate decision-making processes than the previously used yes/no task and has a predictable trend that follows a pseudo-fixed pattern converging towards the threshold. This procedure helps the subject construct an internal representation of the expected target through implicit statistical learning that makes the task more effective (Fiser, 2009; Fiser et al., 2010; Neger et al., 2014). Moreover, trial-by-trial feedback strengthened the stimulus-response association (task rule) by maximizing the decision mechanism through reward (Kumano & Uka, 2013; Lu et al., 2010; Petrov et al., 2005) and in turn increasing both learning and generalization (Herzog & Fahle, 1997; Holloway et al., 2010; Liu et al., 2014; Shibata et al., 2009). Following these modifications, the NVT was then ready for clinical trials. In the article published in Restorative Neurology and Neuroscience in 2014, Professor Casco investigated the effectiveness of the training in low myopia. As proof of the interdisciplinary nature of the Neuro.Vis.Us. laboratory, in this first international publication, the authors include neuropsychologists, orthoptists, and optometrists (Casco et al., 2014). The results showed an abnormal pattern of lateral interactions in patients that were restored following training. More important, after training an improvement in the contrast sensitivity function and the visual acuity was found. Although the training was monocular, there was a transfer of learning to the untrained eye. On the contrary, there was no transfer for other low-level conditions such as different local/global orientations and lower spatial frequencies. Results demonstrated that the new NVT elicited consistent transfer to higher, not lower-level tasks. This testified that the co-activation of perceptual and cognitive mechanisms during training had produced both PL and generalization in a clinical population (low myopia).

Later NVT applications

Later NeuroVis.US studies will extend the scope of the NVT paradigm to other clinical populations. A second data collection investigated the feasibility of lateral masking-based visual rehabilitation in patients with macular degeneration. These patients, due to foveal damage, are forced to use a peripheral retinal locus for tasks requiring high visual acuity and good fixation stability. In some cases, the patient develops a preferential retinal locus (PRL), which takes over the functionality of the damaged fovea (Riss-Jayle et al., 2008). Vision in the PRL is not comparable to foveal vision, as it suffers from high visual crowding and low sensitivity for high spatial frequencies.

The goal was to improve the residual visual function in the PRL of patients. Besides, we also aimed to study spontaneous neural adaptations in patients with acquired foveal blindness. The ambitious project was initially part of Dr. Maniglia Ph.D. studies (Maniglia et al., 2016). Three patients and three age-matched controls were tested with the Yes/No task with no feedback, while the second group of four patients and three controls were tested with the temporal-2AFC with feedback. Both procedures produced significant improvements in the trained task, and the learning transferred to visual acuity. As evidence of the effectiveness of the work done to optimize training, only the group trained with the temporal-2AFC task had transferred to the untrained spatial frequencies and learning retention at follow-up. This study, which opened the use of NVT to visually impaired people, was followed by a third study in which the paradigm with temporal-2AFC and feedback was tested on a group of amblyopic patients (Barollo et al., 2017) and the fourth study with patients with albinistic bilateral amblyopia (Battaglini et al., 2021). In both studies, the altered pattern of lateral foveal interactions was characterized before training by reduced extension of facilitation. The extent of facilitation increases after training, such that the pattern of lateral interactions resembles that of controls. The increase in facilitation corresponds to an improvement in higher-level visual tasks. For amblyopes in the 2017 study, there is further improvement at follow-up compared to post-test, indicating consolidation of visual gain.

Discussion

The studies presented testify to the effectiveness of lateral interaction-based training in improving vision in different clinical populations. Summarizing the results:

- PL is characterized by high specificity resulting from the selectivity of training stimuli. Selective stimuli and prolonged training produce strong PL but also strong specificity.
- The amount of generalization of PL is influenced by "executive" features of the task. The introduction of feedback, an adaptive level of difficulty, and a challenging task (temporal-2AFC) promote via top-down modulation of PL transfer

to untrained tasks.
- Transfer is unlikely for low-level untrained features, while it is likely for higher-level tasks that rely on the trained feature. With NVT, transfer is found to CSF, visual acuity, and crowding.
- Early (amblyopia, albinistic amblyopia) and late (low-myopia, MD) visual pathologies result in impaired lateral interactions that can be improved with training (strengthening facilitatory connections).
- Training with the lateral masking paradigm can be adapted to different clinical populations, and visual improvement is also generally durable at later follow-ups.

Other studies using a similar paradigm have been published in recent years, and the line of research is far from exhausted. The goal, however, remains to maximize transfer or explore applicability to other clinical populations (Campana & Maniglia, 2015). One of the most recent developments has seen the application of transcranial electrical stimulation (tES) techniques to training with the lateral masking paradigm. Continuous anodal (Raveendran et al., 2020) and random noise stimulation (Campana et al., 2014), in particular, appear to enhance learning and perceptual transfer as well as directly modulate lateral interactions (Battaglini et al., 2019). Thanks to the experience accumulated in clinical practice at the NeuroVis.US Laboratory, the NVT protocol has been implemented with more recent features that optimize its effectiveness. For example, home training starts from lower spatial frequencies and then scales up to higher ones when the patient's thresholds approach the floor. Or again, patients are trained in different orientations to maximize transfer to visual acuity, but in different training sessions to avoid interference in feature learning. In addition, in each session patients are trained on multiple lambdas (from facilitatory to inhibitory), for a total of about 40 minutes of training four times a week. In essence, maximum personalization is given to the participant's training. This is what I consider the legacy that Professor Casco left to the NeuroVis.US laboratory. The portfolio of protocols has been greatly stretched over time (hemianopsia, optic neuritis, nystagmus, macular degeneration, etc.) but all protocols although strongly scientifically derived, are adapted and calibrated to the patient's individual residual abilities and deficits.

Conclusion

In conclusion, the uses of the lateral masking protocol in visual rehabilitation has been shown to be feasible and effective. But there is more to it than that. This narrative exposes a working model where basic and applied research contaminate (and improve) each other. The success of the translational method promoted by Professor Casco stems from the application of typical psychophysical measurement techniques to individualized visual rehabilitation. From a human perspective, this narrative demonstrates Professor Casco's commitment to returning the vision sciences to a less notional and more factual perspective. This commitment is reflected in the work of the NeuroVis.US laboratory and consequently in the community in which it operates.

Acknowledgment

I would like to express my gratitude to Professor Clara Casco, for her priceless continuous guidance. Sincere thanks to all members of the NeuroVis.US Laboratory, and in particular to Dr. Luca Battaglini and Dr. Marcello Maniglia, who have been both great friends and great colleagues.

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Due Articoli sui Potenziali Evocati Visivi (VEP) in Risposta alle Texture di Linee Orientate

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La prima volta che vidi Clara Casco fu durante una “magica” lezione di Clara, tenuta in sostituzione di non ricordo quale docente, di non ricordo quale corso per la laurea in Psicologia Generale e Sperimentale a Padova. Senza saperlo esattamente o coscientemente, avevo fatto l’ingresso nell’*intricato* circuito neuronale del sistema visivo umano, sia nei processi percettivi sia nelle basi della corteccia visiva. Un paio di anni dopo mi laureai con Clara Casco e Alberto Mazzocco come relatori con una tesi sulla simulazione del “random-dot kinematorgam” tramite le reti neurali. Desidero ricordare anche Sergio Roncato, che è stato una presenza costante nel mio percorso di ricerca, senza che io ne fossi del tutto consapevole. Ascoltai Sergio Roncato la prima volta quando dovevo decidere al termine del secondo anno quale indirizzo intraprendere tra quelli offerti dalla Università di Padova. Era una lezione di presentazione all’Istituto di Psicologia di Milano in via Francesco Sforza in una giornata caldissima. Lo incontrai di nuovo alla prova d’accesso al Dottorato a Pavia. Poi di nuovo a Padova per l’assegnazione di una borsa post-Dottorato.

Avevo conseguito il Dottorato a Pavia a novembre del 1996. Mi recai poi subito a Padova per salutare e incontrare i miei professori, da cui avevo imparato tutta l’abilità e il mestiere della ricerca sperimentale in psicologia. Rimasi a Padova fino a settembre 1998, allorché presi servizio il primo ottobre 1998 a Urbino. Quindi quasi due anni— fu un breve ma intensissimo periodo in cui lavorai insieme a Clara Casco e a Sergio Roncato.

Portai a Padova la mia esperienza di ricerche che utilizzavano le texture visive, esperienza che avevo maturata durante gli anni di dottorato a Pavia. Con Clara Casco proseguimmo questa direzione fruttuosa di ricerca. Ci occupammo dei correlati elettrofisiologici (EEG e VEP) della visione utilizzando le texture visive. Nel laboratorio di visione di Clara Casco c'erano gli studenti e amici che lavoravano alacremente: Marika, Mauro, Laura, Alessia, Giancarlo, Marco – e tanti altri di cui non ricordo il nome. Tutti lavoravamo intensamente in quei limitati metri quadrati.

Clara Casco ed io cercavamo di scoprire perché alcuni elementi di una texture di linee scompaiono percettivamente per effetto del contesto, creando la rappresentazione mentale di una superficie continua a partire dagli elementi discreti di texture. Le influenze a lungo raggio erano la condizione per il loro "scomparire" e non essere affatto percepiti. Si trattava di *illusioni* percettive della durata di alcune centinaia di millisecondi, un tempo enorme rispetto ai circa 3 ms per lo spike del singolo neurone.

Furono due anni di solerte attività di ricerca, che diede frutti, nel senso di pubblicazioni scientifiche. Diversi articoli e atti di convegno furono pubblicati in quei due anni o negli anni successivi, dati i tempi talora assai lunghi necessari al processo di peer-review delle riviste scientifiche. Mi limiterò a due articoli rilevanti.

Figura 1.

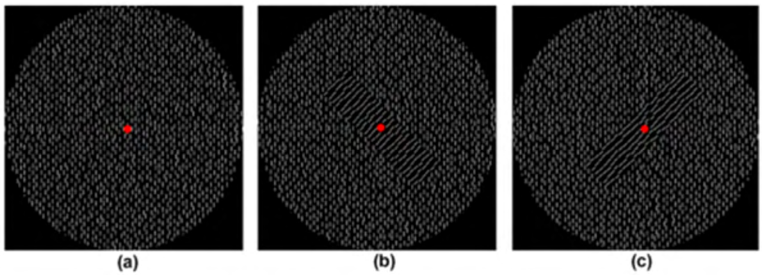

Figura 1. *(a) texture di sfondo; (b) texture con figura a configurazione "ortogonale" rispetto all'asse maggiore di simmetria della figura globale; (c) texture con figura a configurazione "collineare" rispetto all'asse maggiore di simmetria della figura globale (Casco et al., 2005).*

Nel primo articolo (Caputo & Casco, 1999, "*A visual evoked potential correlate of global figure-ground segmentation*") eravamo impegnati alla ricerca di un segnale elettrofisiologico nei potenziali evocati visivi (VEP o potenziali in relazione all'evento, ERP) prodotti da una figura che si segregava dallo sfondo. Figura e sfondo erano definite da texture di linee elementari orientate (Figura 1). Il compito dell'osservatore era discriminare l'orientamento della figura globale che il sistema visivo crea tramite il raggruppamento delle linee elementari della texture. È un articolo che definirei cristallino per la purezza quasi platonica e la consequenzialità logica. I risultati indicano due picchi negativi nel VEP della differenza tra risposta alla figura definita da una texture e lo sfondo di sola texture (Figura 1-a). Il secondo picco (N3) mostrava, in modo specifico, una minore *latenza* nel caso di un incremento di segregazione della figura globale più saliente rispetto a una diminuzione di segregazione della figura globale meno saliente. La salienza della figura era ottenuta in due modi. Nel primo modo, la salienza della figura globale era manipolata tramite la collinearità delle linee elementari di texture entro la figura con il contorno maggiore della figura globale (la figura risulta più saliente; Figura 1-c) rispetto a un orientamento ortogonale delle linee elementari di texture rispetto al contorno maggiore della figura globale (la figura risulta meno saliente; Figura 1-b). Nel secondo modo, la salienza della figura globale era manipolata tramite l'interruzione del flusso dello sfondo da parte della figura globale, che poteva essere sia ortogonale al flusso dello sfondo (la figura risulta più saliente) rispetto una condizione di allineamento al flusso dello sfondo (la figura risulta meno saliente). Il risultato di una minore *latenza* del solo secondo picco negativo (N3) nella differenza tra VEP evocato dalla figura-che-segrega-dallo-sfondo rispetto al VEP evocato dal solo sfondo era spiegato come conseguenza del fatto che l'asse maggiore della figura globale veniva elaborato da una area occipitale successiva alla area visiva primaria V1; invece V1 elaborava le discontinuità di orientamento tra le linee elementari della texture ovvero i margini.

Diversi articoli successivi hanno confermato la nostra scoperta e approfondito la nostra interpretazione secondo cui la figura globale è rappresentata dall'asse di simmetria della figura stessa. Tra i più recenti, Wang et al. (2022) hanno confermato il ruolo svolto dagli assi di simmetria della figura globale nei VEP. Altri articoli di Victor Lamme — che fu probabilmente il referee del nostro articolo — hanno citato la nostra ricerca — che fu la prima in assoluto nell'indagare la segregazione della figura dallo sfondo utilizzando i VEP — in relazione all'importante quesito di quale momento della elaborazione corrisponda allo stato di coscienza nel soggetto, tra percepire l'oggetto oppure sapere di percepire l'oggetto. Per esempio, Lamme (2018) oppone i due punti di vista teorici: "*recurrent processing between visual areas suffices for conscious visual experience to arise*" versus "*only when recurrent processing includes the fronto-parietal network do we experience the visual input*" — e i nostri dati sarebbero probabilmente a favore del primo. Ciò che rimane ancora da studiare del nostro articolo (Caputo & Casco, 1999) in modo più approfondito è il ruolo del "flusso" della texture dello sfondo (*filling-in* dello sfondo di texture) nella segregazione della figura globale e dell'incremento di salienza quando la figura globale *interrompe* il flusso di texture dello sfondo.

Nel secondo articolo (Casco, Grieco, Campana, Corvino, Caputo, 2005, "*Attention modulates psychophysical and electrophysiological response to visual texture segmentation in humans*") indagavamo il ruolo dell'attenzione nella segregazione della figura globale dallo sfondo. Nel precedente articolo (Caputo & Casco, 1999) l'attenzione era allocata alla figura globale, ovvero all'asse maggiore di simmetria della figura, poiché il soggetto doveva discriminare il suo orientamento globale.

Nel secondo articolo (Casco et al., 2005), l'attenzione era manipolata sperimentalmente in diverse condizioni, in particolare l'attenzione era allocata sul lato breve della figura globale (Figura 1). È abbastanza evidente che in tal modo si crea una situazione "incongruente" che richiede una maggiore richiesta di attenzione selettiva e/o di selezione della risposta al compito (il lato breve della figura globale) e il "disancoraggio" della risposta più percettiva e immediata (il lato lungo della figura, ovvero l'asse maggiore di simmetria della figura globale). In questo secondo articolo eravamo alla ricerca di un segnale nei VEP corrispondente alle differenze nella attenzione in contrasto con il raggruppamento percettivo. È un articolo teso e complesso, in cui diversi risultati meriterebbero ancora oggi una indagine sperimentale. Il risultato è notevole: il "disancoraggio" dell'attenzione dal compito percettivo (rispondere all'orientamento della figura globale) al compito che richiede selezione (rispondere all'orientamento del lato breve figura globale) è associato a una maggiore negatività dei VEP *precedenti* al picco di N3. In particolare, N1, P1, N2, N3 erano ancora più *negative* nella condizione di collinearità (Figura 1-c) rispetto alla condizione di ortogonalità (Figura 1-b). Quindi l'attenzione è richiesta dal compito "incongruente" a uno stadio più precoce della percezione della figura globale. Ricordo che il potenziale negativo dei VEP corrisponde all'*incremento* di attività neuronale, in termini di frequenza di scarica dei neuroni sottostanti alla posizione dell'elettrodo sullo scalpo, per una questione di ioni negativi rimasti liberi all'esterno del neurone allorché gli ioni positivi sono utilizzati per lo spike all'interno del neurone, isolato elettricamente dell'esterno.

Quindi, considerando insieme sia i risultati di Caputo & Casco (1999) sia i risultati di Casco et al. (2005) si ottiene la seguente conclusione. L'elaborazione della figura globale, che avviene grazie al raggruppamento delle linee elementari orientate, richiede attenzione e produce una rappresentazione dell'asse maggiore di simmetria della figura con minore latenza di N3 nella condizione di collinearità. Quando invece il compito è di sopprimere tale risposta per l'asse maggiore di simmetria e di selezionare la risposta per il lato breve (quindi una risposta ortogonale all'asse di simmetria) allora è ulteriormente *incrementata* la risposta di raggruppamento già dalle prime fasi di elaborazione (da N1 in poi) ma soltanto per quanto riguarda l'ampiezza (più negativa) ma non la latenza. È come dire che per selezionare una risposta “incongruente” rispetto all’organizzazione figurale (asse maggiore di simmetria della figura) l’elaborazione dell’attenzione deve in primo luogo *rafforzare* tale organizzazione della figura (quindi una “*object-based attention*” o “attenzione basata sulla figura”) per poi *non* selezionarla. Un risultato senz’altro interessante e che richiederebbe ulteriori indagini. Fa parte del *mistero* di come circa 1.5 kg di materia cerebrale possa dare luogo alla coscienza della materia stessa, dove il termine coscienza è nel senso di Agostino (“*Si fallor sum*”) e di Descartes (“*Cogito ergo sum*”), che, nel caso della coscienza visiva, è “sapere di vedere”.

Questa coscienza visiva è certamente necessaria per il compito di discriminazione dell’orientamento sia dell’asse maggiore della figura (Caputo & Casco, 1999) sia del lato minore della figura (Casco et al., 2005). Essa è probabilmente correlata alla componente P3 dei VEP (Lamme, 2018) che sostanzialmente misura l’attività elettrica della corteccia prefrontale così come appare nel polo occipitale dello scalpo. Purtroppo la P3 non è stata valutata nei nostri articoli; tuttavia è evidente dai grafici di Caputo & Casco (1999) che la P3 risulta avere anche essa una latenza molto minore nel caso della discriminazione dell’asse di simmetria per la figura più saliente (texture “collineare” alla figura globale; Figura 1-c) rispetto alla figura meno saliente (texture “ortogonale” alla figura globale; Figura 1-b). Questo risultato sarebbe perciò a favore dell’idea che “*only when recurrent processing includes the fronto-parietal network do we experience the visual input*” (Lamme, 2018). Questa idea del coinvolgimento della corteccia prefrontale è avvalorata dai risultati di Casco et al. (2005) che mostrano che *non* esiste più differenza tra le due P3 quando il compito “incongruente” del soggetto è selezionare con attenzione selettiva l’orientamento del lato minore della figura, sopprimendo quindi la risposta percettiva dell’asse di simmetria della figura globale.

Quel “magico” giorno di lezione di Clara Casco, dove si illuminò la strada da percorrere, fu determinante per tutta la mia vita a venire. Una “iniziazione” nel significato originario di “inizio” di un viaggio di vita per me — e certamente anche per altre studentesse e altri studenti di Psicologia a Padova. Era stata una azzurra “illuminazione” — azzurra come il colore chiaro degli occhi di Clara — che mi aveva colto e che mi aveva preso con sé. Dopo un lunghissimo viaggio, dopo questo girovagare per un paesaggio ancora sconosciuto e per la maggior parte inesplorato, ancora da percorrere e raccontare — non misurabile dagli anni — finalmente mi è ritornato in mente quale fu l'insegnamento "iniziatico" di Clara a me, quello che determinò tutto lo sviluppo futuro mio: il miracolo di *Vedere*.

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Percezione di Raggruppamenti Spaziali in Proiezione Assonometrica

Sandro Bettella e Sergio Roncato

(quando il detto "ad impossibilia nemo tenetur" è contraddetto)

Come ritrovare la terza dimensione perduta nella proiezione retinica? Domanda su cui sono stati versati fiumi di inchiostro e spese risorse sperimentali tra le più rilevanti. La domanda si è trasformata nel quesito "Su quali indizi lavora il cervello per costruire la corporeità del mondo in cui agiamo?" Nei manuali ha quindi un posto importante la rassegna di questi indizi ma con un dubbio di fondo: queste informazioni non sono sufficienti oppure hanno una utilità limitata (ad esempio non sono utili per stabilire la distanza di oggetti molto lontani). Kanizsa (1978) ci ha insegnato a far tesoro dell'esperimento di Metzger sul *ganzfeld* e considerarlo come la prova principale che lo spazio psicologico è in origine tridimensionale, non necessita di elaborazioni per diventare tale.

Ci sono prove molto semplici da portare come dimostra la Figura 1, ma le prove più convincenti si producono con stimoli in movimento. Gli effetti stereocromatici scoperti da Benussi e Musatti (Musatti, 1924) traggono origine dalla rotazione di un cerchio all'interno del quale, in posizione eccentrica, è disegnato un cerchio più piccolo. Pochi punti luminosi in movimento possono sembrare la parte visibile di un solido che ruota: ad esempio due punti luminosi che si avvicinano e si allontanano ritmicamente vengono percepiti come due punti di un disco rotante, serie di punti disposti a sinusoide e fatti oscillare in verticale possono essere visti come una spirale cilindrica in rotazione (grazie all'apparato messo a punto da Sandro a metà anni '80 avevamo a lungo esplorato questo effetto con Clara).

Figura 1.

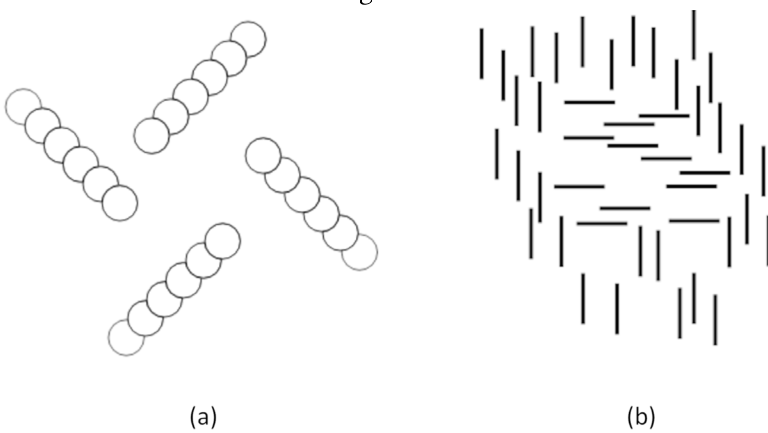


Figura 1. (a) la stessa riga di cerchi parzialmente sovrapposti replicata quattro volte con orientamenti differenti. Le singole configurazioni appaiono disposte in profondità, l'estremità con il cerchio parzialmente coperto più lontana. (b) i segmenti orizzontali appaiono disposti a formare una superficie, quelli verticali invece sembrano perpendicolari a questa superficie. Si ruoti la pagina di 90 gradi e si vedrà l'effetto invertirsi.

Nei casi appena considerati la percezione della profondità è arbitraria ma non del tutto. Ci sono degli indizi che permettono di stabilire cosa è dietro o davanti: si tratta delle giunzioni a T oppure delle differenze di velocità e direzione del movimento. In assenza di informazioni di questo genere quale organizzazione percettiva può sorgere? Riusciamo a disporre nello spazio degli oggetti senza avere informazioni sulla loro distanza? La domanda sembra assurda ma questo non ha scoraggiato gli studiosi di psicologia della percezione. Come disporrà nello spazio dei punti luminosi un osservatore che li vede nel buio? Luneburg (1950) ha dato una prima risposta: allinea dei punti in orizzontale che poi si rivelano essere disposti lungo un'iperbole. A questo esperimento sono seguiti diversi altri che hanno confermato solo in parte la scoperta (Erkelens, 2015, 2021).

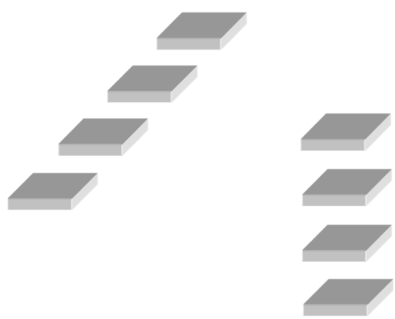
È una direzione di ricerca poco frequentata ma che merita di essere approfondita. Qui prenderemo in esame le disposizioni percepite nello spazio di sagome geometriche di solidi come parallelepipedi e cilindri. Useremo semplici disegni assonometrici di forme cubiche delle quali si possono osservare interessanti fenomeni di raggruppamento percettivo. Con questa espressione si fa riferimento a quei fenomeni che accadono nel mondo percettivo quando le unità figurali disegnate su una superficie piana formano degli assembramenti obbedendo a caratteristiche comuni, come il colore, oppure a geometrie, come la distanza. Cosa accade quando gli stessi oggetti hanno delle caratteristiche spaziali, ovvero contengono delle informazioni sul loro orientamento nello spazio tridimensionale?

Nella Figura 2 è illustrata una prima dimostrazione utilizzando come unità dei parallelepipedi aventi una delle tre dimensioni ridotta al minimo e che chiameremo per questo "lamellari" o "tavelle". Due serie di questi solidi sono disposte lungo due differenti direzioni. Essi formano un raggruppamento percettivo come sarebbe messo in evidenza se fossero contornati da numerose altre unità disposte a caso. Diventerebbero facilmente distinguibili come insieme unitario grazie a dei "fattori di unificazione": l'allineamento delle estremità e la regolarità degli intervalli che separano i parallelepipedi. Il fatto che le figure componenti siano disegni assonometrici, quindi rappresentazioni della terza dimensione, fa sì che In questa organizzazione appaiano proprietà ulteriori. Le tavelle nella Figura 2a sembrano disposte sullo stesso piano orizzontale mentre nella Figura 2b formano una pila (verticale). Si tratta di una differente organizzazione nello spazio che trae origine da due direzioni lungi cui disporre percettivamente i solidi: l'asse comune sulla faccia superiore delle tavelle (Figura 2a) oppure l'asse comune perpendicolare a questa superficie (Figura 2b). va ricondotta all'asse che i solidi hanno in comune. Chiameremo d'ora in poi le due organizzazioni: "coplanare" e "stratificata".

L'emergere di queste due proprietà sembra scontato: nelle due figure una ricorda una pavimentazione,l'altra una scaffalatura, ma è da stabilire se sia questa analogia a generare l'impressione di stratificazione oppure un fattore organizzativo attivo sul piano fenomenico. Vedremo più avanti che nella geometria è possibile individuare l'azione di questo fattore.

Il disallineamento di una unità ha delle conseguenze curiose sull'organizzazione percettiva. Due casi sono illustrati nella Figura 3. La Figura 3a riproduce l'organizzazione a strati che emerge dalla disposizione delle tavelle lungo il loro asse perpendicolare. Nelle figure sottostanti è illustrato lo spostamento di una delle tavelle che viene fatta scivolare verso la sommità o il fondo del foglio. Nella Figura 3b il parallelepipedo, spostato verso l'alto, sembra disporsi come continuazione del solido di sinistra. Nella Figura 3c la tavella, fatta scivolare in basso, appare come spostata sullo stesso piano del solido di destra. Perciò lo spostamento della tavella causa il suo ricollocamento percettivo su un piano diverso da quello che occupava nell'organizzazione a strati: si dispone come continuazione di uno dei solidi che la affianca.

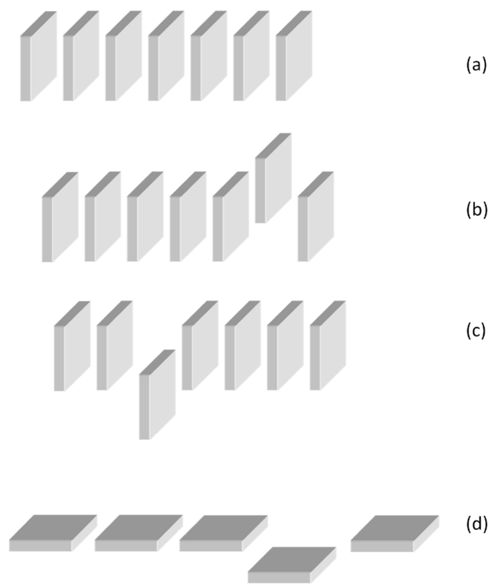
Figura 2.



(a) (b)

Nella Figura 3d lo spostamento di una tavella ha effetti simili. Il parallelepipedo, fatto scivolare lungo l'asse minore della faccia più ampia, rimane coplanare al solido di destra ma sembra distanziarsi a profondità inferiore rispetto al solido di sinistra. Quindi la comparsa dell'impressione di coplanarità o di stratificazione sembra connessa alla disposizione lungo i tre assi dei solidi ma è probabile che intervengano altri fattori.

Figura 3.



Possiamo ricavare alcune conclusioni. L'organizzazione percettiva per strati o "coplanare" non è esclusiva di unità tridimensionali. Esse si realizzano anche con unità unidimensionali: segmenti disposti a intervalli lungo la perpendicolare appaiono come paralleli; segmenti coassiali appaiono come una linea interrotta ad intervalli regolari. Dunque, quello che vediamo nelle Figure 2a e 2b non è sorprendente: allinearsi lungo la direzione dei lati più lunghi genera la coplanarità, l'allineamento lungo l'asse perpendicolare a questi genera il parallelismo. Il disallineamento di una unità ha però delle conseguenze importanti, non solo il raggruppamento viene spezzato ma si modificano le relazioni spaziali. Nella Figura 4 si vedono le conseguenze sul piano percettivo che possiamo schematizzare con questa immagine semplificata: la tavella B è disallineata, conserva la coplanarità con la tavella C ma sembra un gradino più in basso rispetto ad A.

Figura 4.

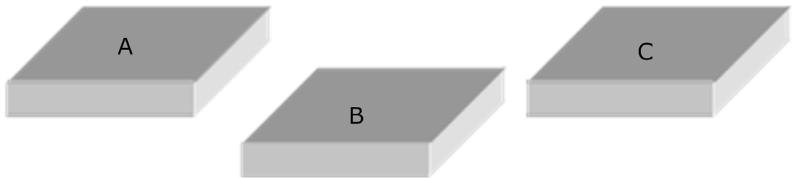


Figura 4. *A* è *coplanare a C, C* è *coplanare a B. Da queste premesse si conclude che A* è *coplanare a B. Ma così non appare. A sembra un gradino più in alto di B.*

È la prima delle incongruenze che si verificano sul piano percettivo quando trovano applicazione queste "regole" di ordinamento spaziale. Osserviamo la Figura 5. È composta di due sottogruppi: una "Z" fatta di tavelle coplanari, una pila di tavelle disposte a strati che interseca (verticalmente) la "Z". Le estremità di quest'ultima appaiono coplanari con le estremità della pila verticale, impressione irrealistica visto che le estremità della "Z" non sono distanziate in verticale bensì sono coplanari a tutte le altre di questo gruppo e quindi a quelle che intersecano la pila al centro.

Il sistema visivo è tratto in inganno dalle condizioni particolari, ma basta "indebolire" questi vincoli alle estremità perché la figura riacquisti il suo vero aspetto tridimensionale. Nell'animazione che è possibile scaricare da internet, possiamo vedere come la configurazione acquisti un aspetto "razionale" appena venga ruotata rispetto all'orientamento che assume nella Figura 5.

Se le estremità della "Z" si allontanano anche di poco dalle estremità della pila, si vedrà l'oggetto assumere una organizzazione visuo-spaziale razionale. È chiaro che il fattore "vicinanza" ha un ruolo importante nell'"agganciare" le estremità dei due gruppi di tavelle: esso fa in modo che appaiano coplanari solidi che appartengono a due piani differenti.

Qui il link al video: https://www.youtube.com/watch?v=sL-t-Twunz-4 *(copiare e incollare l'indirizzo nel browser). Oppure Inquadrare con lo smartphone il QR e collegarsi al link che compare.*

Figura 5.

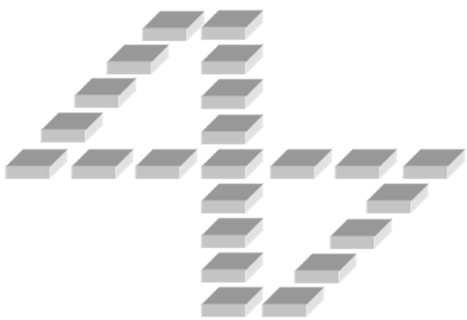


Figura 5. *Parallelepipedi disposti lungo uno dei tre assi. La pila centrale* è *composta di tavelle allineate sull'asse verticale, La "Z"* è *composta di tavelle ordinate lungo uno dei due assi delle facce superiori (o inferiori) dei solidi.*

I raggruppamenti spaziali che abbiamo illustrato danno origine alle stesse immagini irrazionali di Reutersvärd (1982) ed Escher (vedi Locher, 2000) ma senza che si mettano in conflitto gli indici di profondità agendo sulle sovrapposizioni o occlusioni dei lati dei solidi.

Ai vertici di un triangolo di Reutersvärd ci sono degli indizi di profondità molto chiari, se consideriamo un vertice qualsiasi potremo constatare che esso è in opposizione ai restanti due. Non è possibile correggere la prospettiva mentre invece lo è nella Figura 5 nella quale gli estremi della “Z” e della pila non si sovrappongono e quindi non danno informazioni su quale sia più lontano: noi possiamo vedere la “Z” a contatto con la colonna centrale ma anche allontanarsi in profondità.

Allineamento e organizzazione nello spazio

Le due forme di organizzazione, ovvero l’effetto “pavimento” (coplanarità) e l’effetto “stratificazione”, non sono facili da collegare all’allineamento dei lati dei parallelogrammi se prendiamo in considerazione quello che si vede nelle figure 4 e 5. Vediamo gli effetti di alcune variazioni nell’assonometria e nelle dimensioni delle facce.

Nelle Figure seguenti possiamo constatare come la percezione “di taglio” compaia più frequentemente. È stata variata l’assonometria e ridotta la superficie orizzontale delle tavelle. Confrontiamo la Figura 6a con la Figura 6b. Nella prima l’effetto “pavimento” o percezione di coplanarità non è molto chiaro, è instabile specie nella parte centrale. Nella Figura 6b questo effetto scompare del tutto. La riduzione della faccia orizzontale a una losanga molto stretta è sicuramente il colpevole principale della scomparsa dell’impressione di coplanarità. Per essere precisi scompare l’impressione della coplanarità sul piano orizzontale, ma può emergere analoga impressione sul piano verticale. Osserviamo due disposizioni di poco differenti agli estremi. Nella figura 7a predomina l’impressione che le tavelle siano ordinate su pile parallele e ogni effetto di coplanarità sia assente, nella figura 7b predomina l’impressione che le tavelle siano fissate perpendicolarmente a una superficie verticale. Sembrano dei piccoli ripiani allineati e fissati alla parete. Interessante, perciò, la doppia coplanarità: l’una a formare file stratificate di ripiani, l’altra sulla parete verticale. Ci sono, perciò, differenze rilevanti nella organizzazione percettiva delle due ultime figure, attribuibili alla configurazione. In 6c c’è un suggerimento a orientare i gruppi in verticale, in 6d viene privilegiata la direzione obliqua. Saranno queste a dare vita agli effetti di coplanarità o di stratificazione.

Figura 6.

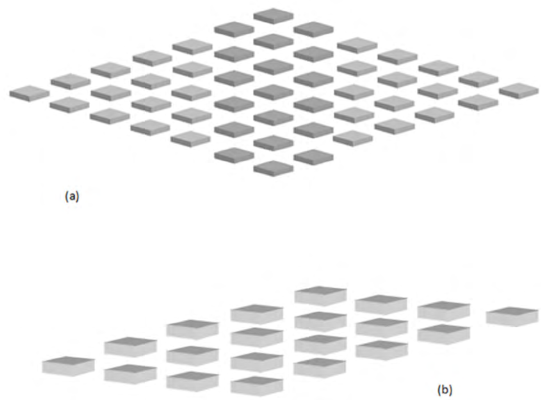
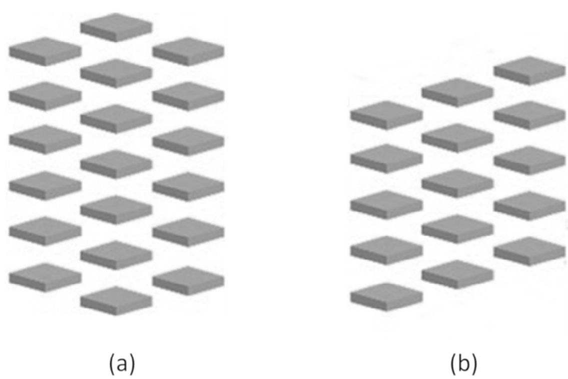


Figura 7.



Conclusione

Parallelepipedi disegnati con minimo sviluppo in altezza, e quindi quasi lamellari, si dispongono nello spazio anche senza indizi di profondità come la sovrapposizione. Abbiamo illustrato due disposizioni spaziali differenti che appaiono come conseguenza di diversi tipi di allineamento. Se la congiungente il centro delle facce superiori segue il lato orizzontale o quello obliquo della faccia estesa del solido, allora appare la disposizione coplanare. Diversamente si ha la stratificazione, proprietà percettiva che prevale in ogni caso quando le facce superiori sono poco estese nella direzione obliqua. La fenomenologia emerge con maggiore complessità quando intervengono variazioni nella configurazione globale formata dai solidi.

Abbiamo messo in evidenza modalità di comparsa multiple: di coplanarità e di stratificazione allo stesso tempo a comporre scenari tridimensionali in cui i solidi si dispongono in organizzazioni gerarchiche (ad esempio: gruppi allineati in orizzontale, stratificati e uniti alla stessa parete verticale)

Quanto sono generalizzabili questi effetti? La risposta richiede esplorazioni più approfondite, una in particolare è necessaria e riguarda gli effetti della variazione di estensione delle facce del parallelepipedo. Nel prossimo paragrafo prenderemo in considerazioni solidi con notevole estensione delle facce laterali.

Coplanarità e parallelepipedi sviluppati in altezza

Come si impone il principio di coplanarità con parallelepipedi veri e propri? Osservate la Figura 8a. In quale posizione percepite questi solidi? Sono possibili due "soluzioni":" come viene illustrato dalle Figure 8b e 8c

Figura 8.

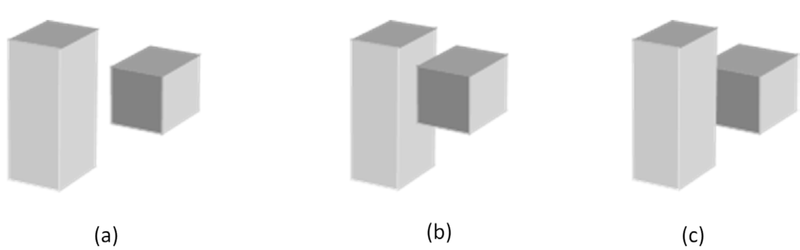
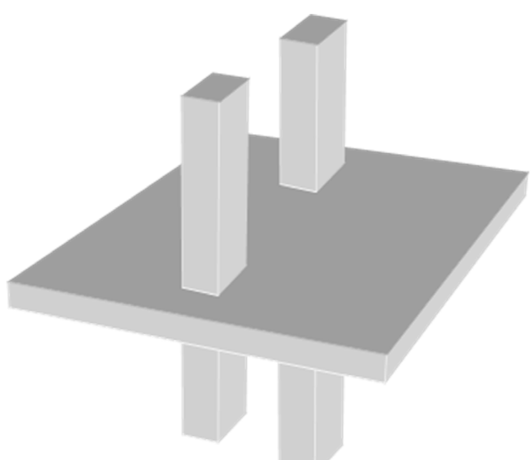


Figura 8. (a) due solidi la cui collocazione relativa è *incerta, può esser quella illustrata in (b) o in (c)*

Gli indizi di occlusione, introdotti nelle Figure 8b e 8c sottostanti, risolvono l'incertezza e mostrano le due diverse collocazioni nello spazio dei solidi. Le giunzioni a T che emergono quando, variata l'angolazione, i due solidi vengono visti parzialmente in sovrapposizione, permettono di collocare il cubo una volta coplanare alla sommità del parallelepipedo e, un'altra volta, coplanare con la base del medesimo. Quello che è interessante rilevare è che la Figura 8a anche se indeterminata nelle relazioni spaziali dà luogo a una organizzazione percettiva stabile; non vediamo né figure fluttuare, né alternarsi nelle relative posizioni (come nelle figure bistabili). Quello che percepiamo nella Figura 8a è un parallelepipedo e un cubo appoggiati su una superficie orizzontale. Tra le due soluzioni (illustrate dalle Figure 8b e 8c) preferiamo quella che colloca i due solidi sullo stesso piano di appoggio. Anche se è possibile percepire un pilastro e un cubo con le sommità coplanari, questa "soluzione" non è percepita, nemmeno temporaneamente, come accade con le figure bistabili. Il principio di coplanarità sembra quindi applicarsi alle basi e non alle sommità. Tra l'apparire "appesi" allo stesso piano o appoggiati alla medesima superficie, viene preferita questa seconda soluzione. Soluzione che si impone con particolare forza "indifferente" alle regole della geometria. Nella figura 9 abbiamo illustrato un caso più eloquente.

Figura 9.



Il parallelepipedo superiore di destra potrebbe apparire sospeso, invece lo vediamo appoggiato al piano orizzontale e allineato all'altro sol lungo la direzione in profondità. I due solidi sottostanti sono percepiti come affiancati e quindi lungo una direzione perpendicolare a quella dei solidi soprastanti. Il criterio che ha ispirato queste "scelte" è presumibilmente il principio secondo cui le basi devono essere percepite come coplanari. Anche in questo caso la disposizione sembra adeguarsi alla regola della coplanarità delle basi. Ma interviene un secondo fattore organizzativo: a dispetto del fatto che sono disposti in direzioni differenti, i pilastri appaiono completarsi. In altre parole, invece che tre o quattro solidi ne vediamo due, composti da una parte superiore e una che sbuca da sotto. In questo caso agiscono due fattori di organizzazione

a. La buona continuazione. Il fattore gestaltico fa in modo che due figure si completino in una sola se i loro margini sono allineati. In realtà si tratta del cosiddetto completamento amodale grazie al quale una parte invisibile acquista una proprietà figurale e diventa fenomenologicamente "occlusa" dal piano orizzontale.

b. La coplanarità delle basi. Due solidi vengono percepiti come appoggiati sulla stessa superficie (base).

Figure impossibili

La Figura 9 è un caso di figura impossibile che di solito viene rappresentata come in Figura 10a. Gli autori di questa figura disegnano due piani che si allungano l'uno in profondità, l'altro di lato. Sembrerebbe l'orientamento di questi piani il fattore determinante la disposizione percepita: i solidi allineati in profondità nella metà superiore e di lato in quella inferiore

La Figura 9 dimostra invece che lo stesso effetto si ottiene anche senza questo "suggerimento" ma grazie al principio che stabilisce la coplanarità delle basi. L'animazione allegata illustra ancora meglio gli effetti illusori.

Figura 10.

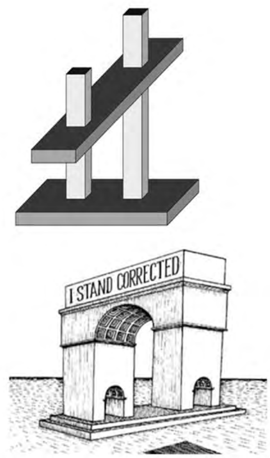
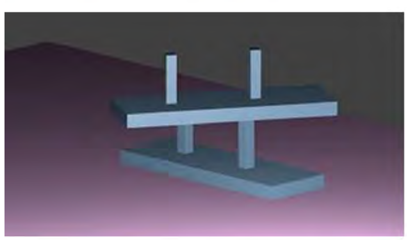


Figura 10. (a) da Reutersvärd (1982). (b) da Shepard (1990)



Qui il link al video: ***https://youtu.be/3bUrU0CVCYg*** *(copiare e incollare l'indirizzo nel browser). Oppure Inquadrare con lo smartphone il QR e collegarsi al link che compare*

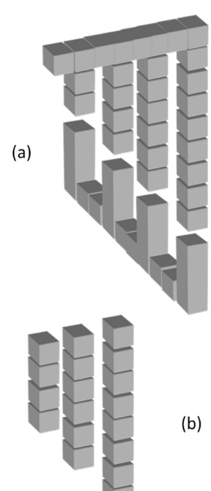
a 10b riproduce l'illusione di Shepard nota come "Arc du Triomphe" (Shepard, 1990; p. 91). Base e sommità del monumento in direzioni perpendicolari e quindi figura impossibile. Anche in questo caso il rettangolo a scalini su cui l'arco poggia non ha responsabilità perché l'effetto paradossale si ottiene senza disegnare questo particolare. Sono le basi dei pilastri che appaiono percettivamente coplanari.

Nella Figura 11 sono state illustrate due condizioni nelle quali il fattore della coplanarità agisce in modo parzialmente o del tutto autonomo. Nella Figura 11a la metà superiore si vede estendersi lateralmente mentre quella inferiore si spinge in profondità. Potrebbero influire in questo la traversa disegnata sulla sommità e la fila di solidi sottostante ma la Figura 11b, nella quale questi particolari sono assenti, l'effetto paradossale si ripresenta anche se meno vivido.

Si noti che la Figura 11b riproduce l'effetto "figura impossibile" del triangolo di Reutersvärd (1982) e Penrose (1958). Tuttavia, non ci sono indizi di profondità che ci impediscono di vedere un a configurazione regolare. Basta far prevalere solo una delle possibili coplanarità, ad esempio percepire pilastri progressivamente decrescenti in altezza appoggiati sulla stessa superficie.

A conclusione di questa seconda serie di dimostrazioni possiamo considerare dimostrato il principio organizzativo in base al quale estremità dei solidi sviluppati in altezza tendono ad essere percepite come coplanari. Possono essere viste come coplanari solo le estremità inferiori oppure, in contemporanea, anche le sommità e questo con conseguenze paradossali. Infine, la configurazione irrazionale appare resistere anche a interventi correttivi che potrebbero renderla razionale ma a prezzo di percepire le estremità dei solidi a livelli differenti.

Figura 11.



Conclusione

Parallelepipedi disegnati sulla superficie dimostrano l'azione di fattori di unificazione che emergono nella rappresentazione tridimensionale dello spazio. I solidi che abbiamo osservato sono costituiti da due classi, quella che abbiamo chiamato lamellare (o tavelle) comprende quadrati e rettangoli di poco spessore e quindi più accentuati come rappresentazione bidimensionale che tridimensionale. La classe comprendente i cosiddetti piloni è costituita da solidi sviluppati principalmente in altezza. Le unificazioni nella prima classe si manifestano in due modi: come disposizioni coplanari o a strati (o a livelli).

Quali elementi geometrici promuovano l'una o l'altra organizzazione non è chiaro. È possibile che questo possa essere ricondotto a un fenomeno di base osservabile con elementi unidimensionali: i segmenti che nella Figura 1b si dispongono o sul piano orizzontale oppure come linee parallele in verticale. Nella Figura 12 sono stati disegnati i lati verticali delle tavelle in due disposizioni differenti. La collocazione sul piano percettivo è diversa nei due casi. Nella Figura 12a è probabile che si vedano segmenti che sono fissati a una superficie comune su cui si ergono verticali. Nella Figura 12b è probabile che si vedano i segmenti disposti su un piano che si dirige in profondità.

Figura 12.

Nella classe di solidi sviluppati in altezza l'effetto coplanarità è ben visibile alla base dei piloni ma anche alla sommità. Le osservazioni che abbiamo fatto sono limitate e potrebbero suggerire che tale effetto derivi dalla tendenza a unificare le estremità dei solidi quando esse si trovano allineate lungo i lati dei due piani. L'ipotesi si rivela fallace non appena sostituiamo i parallelepipedi con dei cilindri.

Questi fattori di unificazione agiscono localmente (aggregano unità adiacenti nello spazio) ma non agiscono in modo "coordinato" cosicché possono emergere percettivamente delle organizzazioni impossibili. La Figura 5 per le forme lamellari e la Figura 8 per i piloni sono la dimostrazione più chiara di come le unificazioni locali (che emergono come coplanarità) siano incompatibili. Nella seconda entra in gioco un ulteriore fattore di unificazione (buona continuazione e completamento amodale) ad "aggravare" l'irrazionalità dell'organizzazione percepita. Ancora una ulteriore conferma della capacità, se così si può chiamare, della nostra mente di percepire l'impossibile. La capacità è ben nota dallo studio delle figure impossibili degli autori succitati, ma in questo lavoro abbiamo visto che la soluzione irrazionale non è l'unica, altre organizzazioni, razionali, sono possibili.

È possibile dalle dimostrazioni qui riportate dare qualche risposta agli interrogativi sollevati dalle figure impossibili? Sono state compiute numerose ricerche da cui emerge una notevole difficoltà a riconoscere nelle sagome qualcosa di impossibile (Donelly et al. 1999; Hochberg, Freud et al., 2013). Le osservazioni circoscritte a porzioni di queste non possono rivelare qualcosa di paradossale perché le contraddizioni emergono da una prospettiva globale ovvero da un confronto simultaneo di tutti gli indizi di profondità (Freud et al, 2013; Tsuruno, & Tomimatsu, 2017). Le ricerche non hanno dimostrato diversità di elaborazione delle informazioni sia nella fase primitiva del processo che nell'elaborazione olistica. Qui si conferma la facilità con cui emergono nel mondo percettivo configurazioni che sono in aperta contraddizione con le regole geometriche. L'unità degli oggetti viene mantenuta a dispetto della dislocazione delle sue parti in luoghi differenti. Gli psicologi ogni tanto fanno incursioni in campi della fisica in cui le leggi in vigore nelle grandezze normali vengono violate, i risultati di questi parallelismi sono a dir poco imbarazzanti. Non vorremmo cadere qui nella stessa tentazione. Certo che di materia per la riflessione non manca. Questa riflessione di Gregory (2005) merita di essere riportata per esteso: "Knowing conceptually that the ends (del triangolo di Penrose, nda) are separated in depth does not destroy the visual paradox. That conceptual understanding does not correct the illusion shows that perception can be powerless to correct errors of understanding, and the reverse is also true. This shows modularity of the brain. It also highlights why we need scientific method to gain reliable understanding from perception, and to guard against illusions. If we could see only probable objects, we would be blind to the unlikely; but this would be dangerous, as unlikely events do sometimes occur. Indeed, if we could see only expected things and events, there could hardly be perceptual learning. The ability to see impossibilities raises issues of how the brain represents. The Gestalt psychologists thought the brain represented objects with similar-shaped brain traces. Such isomorphism is a commonly held notion; though it is deeply flawed, as recognized over 2000 years ago by Theophrastus" (Gregory, 2005; p. 1245).

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Parte 2 Ricordi e Contributi Liberi

Appreciative Recollections and Connections with Professor Clara Casco

di George Mather

University of Lincoln, UK

It is a great pleasure and a privilege to be part of this Festschrift to celebrate the career of Professor Casco.

Recollections

I first met Clara in the early 1980s when she was carrying out postgraduate research with Professor Michael Morgan at University College London. At that time, I had just joined UCL as a post-doctoral researcher working with Michael too. Our paths crossed only briefly in London because Clara soon returned to Italy and I moved to an academic position at the University of Sussex. We would meet occasionally at conferences to exchange news, then twenty years later we began a very fruitful research collaboration, which gave me many opportunities for trips to Padua (which I accepted eagerly of course).

The collaboration was prompted by a visit to Padua in 2002 to give a seminar to the department, hosted by Clara. After the talk I visited Venice for the first time with my wife, and Clara had arranged for us to stay in a 'bed and breakfast' room at the Palazzo Ca' Zenobio. It took us a long time to find the building in Dorsoduro, even with the map that Clara had generously given us. But it was worth tracking down for the strange and wonderful experience of having so much of the old palazzo to ourselves as we tried to find the breakfast room. This introduction to the city has led to many subsequent visits.

The research collaboration really began in 2004 with another trip to Padua, when these photographs (Figure 1) were taken. My accommodation at the time was also in Venice (again organised by Clara), so at one point a few members of Clara's lab took a day trip for a meeting there.

Figure 1

Another highlight for me was the month that I spent at the university in 2013 as a Visiting Scientist, when some very knowledgeable locals (Figure 2) showed me one of the best bars in Padua for spritz and snacks.

Figure 2

Over the years quite a few of Clara's students have visited my lab in the UK as well, including Luca Battaglini of course. Here are photographs of two other visitors which I happened to find in my photo collection (Figure 3).

Figure 3

The collaboration has been a source of great pleasure to me personally. Clara has been a wonderful collaborator; kind, friendly and generous while maintaining the necessary scientific rigour in our research. The students I have met from her lab are also a great credit to both Clara and to the university. It has been a privilege to work with

Clara and her colleagues and students, and to get to know Padua and Venice.

Connections

Clara's research has spanned a very wide range of issues in vision, from figure-ground segmentation to motion perception and developmental dyslexia. Participant populations have included students (of course) as well as children and clinical patients. A full spectrum of techniques have been used too, extending from psychophysics to direct brain stimulation and clinical case studies. Much of this research has been conducted with networks of collaborators both within Italy and internationally.

To give a brief flavour of some of Clara's research I will talk about the small part of it that has involved our collaboration. The common thread running through our shared interest centres on motion perception, and particularly the interaction between motion processing and form processing in the visual system. According to the conventional wisdom in the scientific literature, visual information processing in the brain is divided into two streams. Ungerleider & Mishkin (1982) proposed that the two streams constitute parallel, segregated systems. One system analyses spatial form (the ventral pathway) and the other analyses visual motion (the dorsal pathway). Although there has been some debate about the details, the two streams theory is still widely accepted.

From early in her research career Clara has raised questions about the extent of this segregation. One of her earliest papers concerned the perception of form mediated by motion, in which a moving shape can be perceived as a whole even when it is viewed through a slit or aperture that is so narrow that only a thin strip is visible at any one time (Casco & Morgan, 1984). Much of our collaborative research (some of it summarised in a review paper: Mather, Pavan, Bellacosa, Campana, & Casco, 2013) studied how information about spatial form influences motion perception at different stages of processing in the cortex.

Pavan et al. (2011) found that the orientation of moving line segments influences our ability to discriminate their motion trajectory, building on earlier research conducted in Clara's lab (Alberti, Pavan, Campana, & Casco, 2010; Casco, Caputo, & Grieco, 2001; Casco, Grieco, Giora, & Martinelli, 2006). The results of Pavan et al.'s (2011) experiments in indicate that orientation signals are combined with motion signals at an early stage of analysis, as others have also suggested (Ledgeway, Hess, & Geisler, 2005).

These interactions between form and motion probably take place in early cortical areas, namely V1 and V2. However, our collaborative research also found evidence for interactions at higher levels of analysis (Mather, Pavan, Bellacosa, & Casco, 2012). We used an illusion known as the motion after-effect or MAE as a probe. In the MAE, adaptation to a pattern moving in a particular direction subsequently causes illusory movement in the opposite direction (we reviewed research on the MAE in Mather, Pavan, Campana, & Casco, 2008). In one experiment we found that adaptation to movement was stronger when the adapting display was superimposed on a static striped grating pattern that was oriented parallel to its axis of motion rather than perpendicular to it. The same effect was obtained when the movement direction of the adapting display was available only at a higher-level integration stage of analysis in the cortex, probably in cortical area MT (part of the dorsal pathway).

The summary in our review of research in this area (Mather et al., 2013) was that interactions between form and motion occur both at early stages of processing prior to the divergence of the two streams and at later stages after the point of divergence. The general point that information is shared extensively between the two cortical processing streams is becoming more widely accepted (Milner, 2017).

In conclusion I would like to express my appreciation to Clara not only for the research collaboration that has been so successful but also for her generosity and warmth as a colleague and friend. It has been a privilege to work with her.

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Quattro Decenni in Giro per il Mondo (Percettivo) e la Sensazione di Aver Visto Solo Poco.

di Sergio Roncato

Gli psicologi la chiamano "flash-bulb memory", è un ricordo meticolosamente preciso del contesto in cui ti trovi quando ti viene comunicato qualche cosa di traumatico. Era poco prima di mezzogiorno quel 16 marzo 1978 quando Luciano Arcuri entrò nella sala del primo piano della sede dell'Istituto di Via Marsala con espressione attonita, ci disse che era stata diramata la notizia che era appena stato rapito Aldo Moro. Restammo ammutoliti, la sorpresa ben presto lasciò il posto allo sconcerto e alla paura; eravamo arrivati alla fase più buia di quella stagione sciagurata. Mi rimane questo ricordo come l'ultimo di quel periodo in cui con Clara avevamo iniziato e stavamo per concludere un'impresa per noi importante. Forse era oltre le nostre forze ma cercavamo risposte per un progetto futuro di ricercatori. Eravamo in piena "rivoluzione cognitivista"; così appariva, in sintonia con il clima di quegli anni, un fiorire di ricerca ed elaborazione teorica su ispirazione di quella che avrebbe preso il nome di "computer science". La riformulazione di concetti e l'innovazione delle metodologie di indagine che ci provenivano dagli ambienti scientifici anglosassoni offrivano prospettive di indagine molto promettenti. In qualche caso si trattava di novità apparenti, erano piuttosto una rielaborazione di idee note anche se lasciate in margine, ma in altri casi si aprivano questioni di cruciale importanza. Nascevano nuove discipline come la psicolinguistica, nello studio della memoria si ponevano le basi per la costituzione di una disciplina autonoma. Si apriva la possibilità di studiare il riconoscimento visivo o pattern recognition. Gli informatici erano al lavoro da tempo su questa problematica, gli psicologi vedevano con interesse la possibilità di estendere questa indagine al riconoscimento umano. Occorreva pensare come pensa una macchina, spezzettare l'oggetto in componenti verificare la velocità e precisione della risposta, ipotizzare qualcosa, che restituisse a queste componenti unità, identità, significato. E qui nasceva il contrasto con quello che avevamo imparato dai nostri maestri, principalmente la psicologia della forma, la valorizzazione della struttura, dell'intero, dell'organizzazione figurale. Come conciliare questa prospettiva con quella nuova?

Ci mettemmo di impegno a trovare una risposta. Unico elemento di forza: il nostro entusiasmo; lo sosteneva una notevole ingenuità, quella che induceva a minimizzare il fatto che eravamo studiosi acerbi ("crui" in padovano), che il materiale era scarso e mai aggiornato, che non avevamo mezzi, ovvero nemmeno un tavolo e men che meno una posizione. Lavorammo un paio d'anni sul materiale cartaceo che trovavamo nelle biblioteche e quello che qualche ricercatore ci mandava dall'estero. Ne uscì "Realtà e rappresentazione", un volumetto collettaneo per i tipi della Giunti di Firenze. Ricordo il disappunto del curatore per l'eccesso di evidenza grafica del suo nome in copertina. Voleva prendere le distanze, si era pentito di aver appoggiato l'impresa. Forse era il timore delle critiche per quello che sembrava un passo più lungo della gamba di un quartetto di acerbi e baldanzosi neolaureati. Dopo tanti anni, rimango convinto che quello sforzo è stato un passo importante nella nostra formazione.

Quel marzo del '78 stavamo faticosamente chiudendo i primi capitoli, Clara se ne sarebbe andata dopo l'estate, ne persi quasi le tracce per qualche tempo. Ci scrivemmo che era in Belgio e poi a Londra. Era finita quella prima stagione in Via Marsala-palazzo Papafava: un contesto molto particolare. Dimora dei conti, discendenti del casato Papafava dei Carraresi, era stata riadattata a studi e aule per la Facoltà di Magistero. La sede mostrava tutta la sua vetustà ma il pezzo forte era la "corte dei conti": un ampio spazio con cedri centenari che potevamo scorgere attraverso le ampie vetrate che davano sull' interno dell'isolato. Tetto e infissi malconci non assicuravano la dovuta protezione, la pioggia penetrava e nell'aula lezioni entrava in abbondanza. Sandro aveva fatto delle planimetrie per studiare una migliore distribuzione degli spazi, ma una notte che aveva piovuto a dirotto i disegni erano venuti a trovarsi sotto uno sgocciolamento. Rimasero raggrinziti sul tavolone del lato est per anni a testimonianza della salubrità del luogo.

Alla precarietà della sede faceva da contrappunto la precarietà dei frequentatori. C'erano tre o quattro assegnatari ufficiali di studi, ma la sede era popolata da un gruppo nutrito, tra cui Clara e io, di esercitatori, borsisti, contrattisti, laureandi. Dovevi cercarti un tavolo libero ma anche liberarlo in fretta se serviva. Quel posto non si meritava certo ulteriori "attenzioni", invece esercitava un'attrattiva irresistibile per tutti quelli che volevano riunirsi, in particolare per organizzare occupazioni, seminari con negoziazioni di voto politico, intimidazioni dirette o via graffiti o scritti.

Gli squadristi arrivavano con loro comodo, contestazioni, intimidazioni, assedi capitavano quasi giornalmente. Ma c'erano anche laboratori e una attività di ricerca del tutto considerevole. Era uno strano convergere di uomini e psicologie quel palazzo. Nello stesso giorno poteva capitare di affrontare un seminario arginando pretese di voto politico, di trascorrere un paio d'ore in un laboratorio a trascrivere tempi di reazione, di trovare, all'uscita, l'atrio affollato da un intero battaglione di carabinieri in assetto antisommossa. Allora era un vero e proprio problem-solving: voltare le spalle e rientrare in laboratorio non se ne parlava, non c'era che da tentare di arrivare alle scale … ma non si sapeva se pronunciare la parola "permesso" avrebbe innervosito il suddetto battaglione. Sulle scale avresti incrociato il nobile padrone di casa la cui signora era stata scippata della borsa della spesa dagli squadristi ed ecco la ragione dell'intervento delle forze dell'ordine. Non finiva qui, in attesa, al piano superiore, un gruppetto di studenti fuori corso era alla ricerca del titolare che non aveva registrato il loro voto d'esame e che si era trasferito in altra sede anni prima. Ti toccava risolvere la questione se volevi tornare a casa. Rimaneva solo non dare nell'occhio e svignarsela inosservato dalla riunione sindacale in corso.

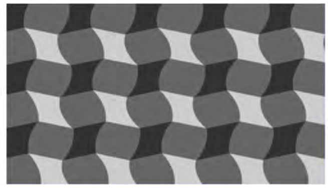
C'era tanta buona volontà ma tanto dilettantismo e improvvisazione, ho capito il perché della scelta di Clara di andarsene quando si rifece viva quattro i cinque anni più tardi. Aveva fatto enormi sacrifici ma aveva frequentato centri di ricerca all'avanguardia. Aveva raggiunto livelli di formazione e competenza invidiabili. Io mi ero perso via, lei volle darmi una mano anche se a riprendere i vecchi percorsi si vedeva che non le andava più. Davanti a un oscilloscopio che si era procurata notammo un "comportamento" delle sinusoidi che apparivano a volte rigide altre volte elastiche, altre volte ancora in rotazione. Le dissi della mia convinzione che il movimento dei flagellati osservati al microscopio si prestasse a “interpretazioni” sbagliate, ad esempio era probabile che un’onda elastica apparisse come la rotazione di una spirale cilindrica (le cose non stavano proprio così ma quello del movimento del flagello è un problema ancora aperto; si veda: H. Gadelha et al. (2020). Human sperm uses asymmetric and anisotropic flagellar controls to regulate swimming symmetry and cell steering. Science Advances, 6(31), eaba5168 e retraction).

Ne discutemmo con Sandro, indispensabile con le sue confutazioni quando vuoi avviare un progetto di ricerca. Fu lui a ideare una associazione di strumenti per generare i movimenti oscillatori. Dagli oscilloscopi venivano fuori combinazioni e composizioni di movimenti di grande interesse. Le oscillazioni armoniche di elementi discreti mostravano interessanti fenomeni di unificazione percettiva. L’unificazione poteva presentare proprietà differenti: l’elasticità/rigidità, bi/tridimensionalità ma apparivano fenomeni nuovi: sincronizzazione forzata dei punti, unificazione a formare una superficie elastica. Quali i parametri fisici da variare per capire l’origine delle differenti organizzazioni percettive? Frequenza, lunghezza d’onda, altezza, ma servivano programmi e attrezzature che non avevamo. L’obiettivo più ambizioso era quello di trovare il minimo di stimolazione visiva necessario per la percezione di un fluido, ad esempio. Non trovammo soluzioni e la ricerca resterà incompiuta, ci consola il fatto che il problema, affrontato quasi trent’anni dopo da un gruppo di ricercatori tedeschi e giapponesi (Kawabe, T., Maruya, K., Fleming, R. W., & Nishida, S. Y. (2015). Seeing liquids from visual motion. Vision Research, 109, 125-138) sarebbe stato in parte risolto.

Finiva anche questa stagione con il nostro trasloco nella sede di Riviera dei Ponti Romani. Didattica, impegni “gestionali” cominciavano davvero a essere un serio impedimento allo studio e la ricerca. Con Sandro ci impegnammo nella ricerca di strumentazioni (il computer Tektronix in particolare) e software specializzati, ma i fondi sono molto scarsi e gli impegni sempre maggiori. Sarà una pausa piuttosto lunga nella collaborazione con Clara che si interromperà con l’ultimo trasferimento nella nuova sede di Via Venezia. Anche in questa occasione lo sprone di Clara sarà determinante; riuscirà ad attrezzare e mettere in funzione due laboratori. La sua dimestichezza con le procedure psicofisiche e la sua competenza metodologica si rivelarono essenziali per la ripresa di alcuni esperimenti di percezione visiva che conducemmo insieme. Riguardavano fenomeni di distorsione percettiva della luminosità molto interessanti ma anche sfuggenti, catturare i quali servivano procedure di indagine particolarmente meticolose e diverse ripetizioni delle stesse prove. È grazie all'impegno e alla perizia di Clara che si riuscirà a superare una serie di difficili ostacoli. Ma ci sarà un risvolto, per così dire, "ludico" di queste ricerche. I fenomeni che stavamo studiando, una volta riprodotti con stimoli e scene complesse, davano origine a effetti illusori curiosi e di notevole intensità. Pensammo di partecipare all'annuale "Illusion Contest" dove si premiano le ricerche, o meglio gli effetti, illusori più interessanti. Sandro fu ancora il supporto insostituibile per questa fase dell'indagine. Si ricompose il trio per questa che sarà l'ultima stagione prima del mio congedo. Sandro riprogettò lo scenario di stimolazione percettiva sia in condizioni statiche che in complesse animazioni cinematografiche. Ne scaturirono nuovi e più evidenti fenomeni percettivi. Tentata la sorte all'annuale "Illusion Contest" riceveremo la nomination due volte, poi la pubblicazione sull'Oxford "Compendium" del 2017. Ma il web sa essere effimero: sparisce "Flash" e con esso tutte le belle animazioni che avevamo inviato al Contest. Le riproponiamo nella pagina seguente.

Con Clara portammo a termine una serie di ricerche sul completamento dei margini percettivi e sul ruolo della polarità di contrasto. Poi Clara decise di impegnarsi in un nuovo progetto centrato sulla riabilitazione dei deficit visivi, una impresa non da poco che richiederà notevoli sforzi sia sul piano scientifico che organizzativo. Da allora non ebbi il coraggio di coinvolgerla in questioni di scarsa utilità pratica come i trompes d'œil. Ma con Sandro, da pensionati, abbiamo continuato e le rendiamo omaggio con questa nostra ultima "fatica" che abbiamo proposto di inserire nella presente raccolta col titolo "Percezione di raggruppamenti spaziali in proiezione assonometrica".

QR code indirizzo video Youtube Grattacieli (senza musica)
(oppure si copia e incolla questo link) https://youtu.be/GBnlCJ8fYUo



QR code indirizzo video Youtube Cubisti Land (senza musica)
(oppure si copia e incolla questo link) https://youtu.be/HLfBUFuNqJg

Ora però vorrei rompere la consuetudine che porta a rievocare tutto quello di positivo che si è fatto e accennare a un qualche rimpianto per qualcosa che non si è fatto. Da tempo ero curioso di alcuni effetti percettivi che si originano nell'"osservazione da un'apertura". Dopo aver letto per caso un articolo sul tema, parlai a Clara del grande interesse della questione. Mi rispose, non senza perplessità, che era stata una delle sue ricerche dei suoi anni a Londra (Casco, C., & Morgan, M. (1984). The relationship between space and time in the perception of stimuli moving behind a slit. Perception, 13(4), 429-441.). Lasciai che mi illustrasse a fondo la questione, anche per farmi perdonare l'ingenuità di non aver voluto prepararmi con la dovuta ricerca bibliografica. Mi convinse che l'indagine presentava notevoli difficoltà sul piano della realizzazione degli stimoli e che il dibattito teorico non offriva al momento delle ipotesi chiare con cui procedere. Aveva ragione, lo sta a dimostrare la scarsità di studi dedicate al problema negli anni successivi. Ma il problema rimane di grande interesse, forse non insistei abbastanza quella volta a illustrare quanto questo si collegasse alle nostre ricerche di tre decenni prima: era il classico problema della relazione fra le parti e il tutto, quel problema che era stato sollevato, e in parte risolto, dalla Psicologia della Gestalt e che questa volta nasceva da una angolazione particolare nell'osservare il mondo: dietro a un paravento e attraverso una fessura. Da quella fessura si vede un oggetto o una scena nella loro interezza se questa è in movimento in direzione perpendicolare alla fessura. Come si ricompone un intero da una striscia che cambia continuamente configurazione? Che cosa sbuca, letteralmente, da quella fessura che permette alla mente di restituire interezza e organizzazione ai frammenti?

I fisici hanno dedicato ben altra attenzione a qualcosa che ricorda il problema della fessura: il problema della doppia fessura o "esperimenti alla Young" (https://en.wikipedia.org/wiki/Double-slit_experiment). Anche in questo caso quello che sbuca dalle fessure è sorprendente. Si proietta su uno schermo come una figura di interferenza facendo ipotizzare una natura ondulatoria di ciò che viene fatti passare. Ma se dalla sorgente vengono emesse elettroni a intervalli in modo che possano essere escluse interazioni fra particelle che passano tra le due fessure, le figure di interferenza ricompaiono. Che cosa esce dalle fessure che produce interferenza al posto di due tracce distinte di impulsi? È ritenuta questa la questione cardine della fisica quantistica, intorno alla quale il dibattito teorico ha segnato uno dei capitoli fondamentali della fisica del secolo scorso. Ma c'è una seconda questione; se introduciamo un dispositivo che sia idoneo a segnalare se da una fessura passa o non passa una particella allora la figura di interferenza scompare e al suo posto le due tracce di passaggio in corrispondenza alle due fessure. Sembra perciò che quello che attraversa le sottili aperture si comporti come un'onda se manca un rilevatore del passaggio del loro passaggio, in caso contrario si comporta come un corpuscolo.

Non è nelle competenze di chi scrive riassumere i punti nodali intorno a cui si è svolto il dibattito teorico. È singolare rilevare come il ruolo dell'osservatore sia determinante quando i fenomeni sbucano da una o più fessure, oppure quando sono ridotti a eventi privi di interazioni con altri eventi. In percezione una striscia di dimensioni ridotte diventa un oggetto o una scena, in fisica si concretizza il dualismo onda-particella. Se individuiamo il percorso della particella questa appare comportarsi come un corpo perché attraversa o una fessura o l'altra: se invece eseguiamo l'esperimento con le due fessure aperte troviamo il pattern di interferenza tipico di un fenomeno ondulatorio. La "relational quantum mechanics" (Rovelli, C. (1996). Relational Quantum Mechanics"; International Journal of Theoretical Physics 35, 1637-1678) nasce come tentativo di dare conto dei fenomeni osservati negli esperimenti "doppia fessura" come il risultato dell'interazione fra osservatore (apparato di misurazione) e fenomeno osservato.

Difficile non farsi tentare dalle analogie con le ricerche nel campo della visione, specie se consideriamo il dibattito sulla questione (https://en.wikipedia.org/wiki/Observer_effect_(physics) https://physicsworld.com/a/do-atoms-going-through-a-double-slit-know-if-they-are-being-observed/https://skepticalinquirer.org/newsletter/mindless-quantum). Ma è meglio non azzardare, gli strumenti conoscitivi della psicologia non sono paragonabili a quelli delle scienze naturali. Rimane la curiosità e insieme a questa il rimpianto di non aver mai avuto i mezzi sufficienti per portare a termine le nostre ricerche.

Il randagio accasato

di Marx

Clara mi ha messo nome Marx. Eravamo compagni di jogging in terra di Puglia. Da randagio che ero ho preferito accettare una casa, temporaneamente in affido nel padovano a pensionato poco propenso alla corsa campestre. Qui si deve girare a guinzaglio, pena zuffe con altri cani, inseguimenti a gatti e relative "discussioni" fra proprietari. Meglio rintanati in un bel appezzamento recintato da cui prendo regolarmente la fuga quando, come spesso accade, il mio ospitante si dimentica uno dei cancelli aperti. Fatto il giretto, mi diverto a piazzarmi davanti al cancello d'entrata nella posa studiata di chi è stato cacciato e attende perdono. Funziona sempre; si fermano anche automobilisti, suonano il campanello e mi consolano. Mi diverte sempre la scenetta del mio "tutore" che esce di corsa e fa finta di disperarsi chiedendosi dove io possa aver fatto il buco nella rete e scappare. Questa psicologia degli umani non è poi così complessa; un po' me la sono imparata ma avrò modo di perfezionarmi. Non sempre è facile. Qualche tempo fa a mezzanotte o giù di lì mi sono fatto aprire e mi sono precipitato fuori ad accertarmi di certi rumori, venivano dal retro della proprietà dove dei galantuomini si erano introdotti senza essere invitati. Da ex randagio so bene come cavarmela e, con l'aiuto del vecchio cagnone, li ho rispediti nel buio. In casa nessun allarme, ma, dopo qualche giorno, scoperto il taglio sulla recinzione, ho avuto l'impressione che i due fatti siano stati collegati. Ho visto sguardi di apprezzamento nei miei confronti… speriamo che si approntino difese opportune perché non posso fare tutto da solo. Fare il cane da guardia non sarebbe male anche perché mi sento di guadagnare il pasto, la merenda e i due stuzzichini quotidiani. Ma mi domando se tutto questo vale la rinuncia alla randagia libertà. Mi mancano quelle corse fra gli ulivi con Clara….

Pour Clara de Marianne, l'Amie Belge … Juin 2022

di Marianne Demuylder

C'était à Bruxelles entre 1975 et 1980. Nous vivions l'après 68, étions des militants politiques, habitions dans de grandes maisons, en communauté. Un soir, je vais manger chez mon compagnon de l'époque, une odeur de sauce, des casseroles d'eau bouillantes, des gnocchis et 2 italiennes aux fourneaux : Clara et Patricia.

Quelques jours plus tard, je vais les retrouver à l'Université Libre de Bruxelles où elles sont chercheuses en section psychologie. Des chambres se libèrent dans notre communauté, je leur propose, elles emménagent. C'est le début d'une belle et longue amitié avec Clara, Patricia partant assez vite parcourir le monde !

Avec Clara, j'apprends ce qu'est la vie d'une chercheuse passionnée, le jour et la nuit peuvent se confondre, le temps importe peu. J'apprends aussi à vivre au rythme de la cuisine italienne liée aux allers-retours de Clara entre Bruxelles et Udine, elle en revient toujours avec du vin, du fromage, des charcuteries. Je la suis aussi en Italie, dans sa famille formidable, à Parme, à Londres et la retrouve toujours pareille à elle-même, la tête plongée dans ses notes, ses livres. Et enfin à Padoue où elle pose finalement ses valises.

Et puis, nous avons eu chacune une fille, quasi en même temps, Anna et Marie. Et bien sûr, elles se sont rencontrées lors de nos visites en Belgique ou en Italie. Un lien supplémentaire s'est créé.

Clara, tu as tenté bien des fois, avec patience de m'expliquer à moi, la littéraire, l'objet de tes recherches, je n'y comprenais pas grand-chose …Mais je voyais briller dans tes beaux yeux, ta passion et ta fierté du chemin parcouru, celui qui t'a mené d'Udine au poste que tu occupes à l'Université de Padoue. Ta persévérance à dépasser les obstacles de la vie pour arriver là où tu es m'a toujours épatée. Sans parler de ta curiosité, de ton ouverture au monde et de ton engagement qui ont alimenté durant toutes ces années, notre amitié.

Maintenant, que nous sommes toutes deux à la retraite et qu'en principe, nous allons avoir du temps …j'espère très vite me retrouver sur ta terrasse à boire un bon verre de vin en compagnie de ceux que nous aimons et poursuivre ainsi notre chemin d'amitié.

A tout bientôt. Je t'embrasse, toi mon Amie italienne.

Genesi

di Renato Cavedon

Partecipo volentieri alla composizione di questa piccola antologia per festeggiare il commiato di Clara dalla docenza universitaria. Chi concorre alla redazione in genere si sofferma su uno o più momenti ritenuti significativi nella carriera accademica contribuendo a definire un mosaico non ordinato cronologicamente e che potrebbe essere realizzato anche attraverso una successione di immagini fotografiche. Nel nostro caso si tratta di testi scritti che comunque descrivono una sequenza di ricordi visuali (e qui la visione si sposa bene con gli interessi di ricerca di Clara) tradotti in parole che non hanno la precisione quasi oggettiva dei fotogrammi ma che sono modellati, idealizzati e comunque parzialmente sfuocati dallo scorrere del tempo. Sono tanti gli episodi, piccoli e grandi, che concorrono a costruire e a definire un po' alla volta le caratteristiche delle persone che frequentiamo, come una specie di Lego che cresce e si arricchisce di sfumature e di particolari, soprattutto se la nostra frequentazione si dipana nell'arco di molti decenni. Ma io ho netta la sensazione che quello che è ed è sempre stata Clara, per lo meno nella mia testa, corrisponda essenzialmente all'impressione che ne ho avuto la prima volta che l'ho incrociata. Molti mi dicono che ho una memoria solida. In questo caso non riesco ad essere preciso. Posso solo dire che siamo a metà degli anni '80, sicuramente in estate, tra giugno e luglio, a cena da un amico compianto, e ricordo di essermi seduto a tavola con altri ospiti chiacchierando con una giovane donna da poco rientrata da una serie di esperienze internazionali e pronta a iniziare la sua carriera accademica a Padova. Il ricordo è chiaramente impreciso in molti dettagli, tanto per dire quanti fossimo a tavola non riesco a dirlo, ma al centro della conversazione c'era lei e questo l'ho ben presente. E quello che conservo nella mente, e che si è consolidato nella frequentazione successiva, ha sempre confermato quelle poche impressioni iniziali, queste sì, chiare e nitide, del suo modo di essere, e che riassumerei in tre semplici parole: curiosità, affabilità e disincantato. La prima, la curiosità, è sempre stata viva e non si è mai appannata nel tempo. E non era solo concentrata sui temi delle sue ricerche ma rappresentava un elemento stabile che governava la sua conversazione con gli altri. L'affabilità è una dote che non le è mai venuta meno e che le permetteva di mettere gli interlocutori a proprio agio. E anche quando non condivideva le opinioni altrui le sue obiezioni le ha sempre espresse in modo pacato e senza precipitazione. Il disincanto invece era una specie di arma segreta che veniva sfoderata nel momento del bisogno, quando tutti i tentativi di cercare un'armonia risultavano vani. Ma queste ed altre doti e caratteristiche forse più importanti, e che non riesco ad elencare, per me sono racchiuse in una cornice robusta che definirei di caparbietà che l'ha sempre accompagnata nella carriera e nella sua vita di relazioni, uno sforzo di volontà che non le è mai venuto meno. È questa una sintesi molto stringata e anche retorica, uno schizzo solo abbozzato che fa torto, mi si perdoni il termine, alla multimedialità della persona. Perché questa amicizia che è iniziata quasi quarant'anni fa è fatta di moltissimi altri fotogrammi, in bianco e nero, colorati e spesso coloratissimi sempre ricchi di attenzione, condivisione e generosità. Un bacio in fronte di ringraziamento per tutto quello che abbiamo condiviso e un augurio grande per tutto quello che verrà.

Clara

di Maria Antonella Viero

La incontro una sera d'inverno, in casa di amici, un caminetto acceso, di sopra un dipinto bianco azzurro titola 'L'agnello di Dio'. Il suo sguardo è diretto, la mano stringe la mia, si respira la forza, mi sorride… Ci siamo già 'conosciute'. Le vite, accanto, un filo a zig zag incrocia il punto come di scala i pioli. Ed è subito curiosità, simpatia, la parola esplode racconta narra… narra la storia di una vita, ciascuna pensata propria e, un tessuto dispone parola, dimentico, al colore del sogno.

Sì, ci siamo già incrociate, per via di nascita, la nascita in un paese, paese dove il tempo sembra indulgere alle cose, le case con porte aperte anche senza nome sul campanello perché si stava come in famiglia, ognuno sapeva dell'altro, la notizia correva lungo una corrente trasversale, fatta di lingua dialettale; ognuno era figlio dell'altra casa, la scuola, ragazzi da un lato ragazze dall'altro… Gli anni '50: traccia e strada verso la gioia di quel che occorre si compia.

Il paese dove nasce Clara è Martignacco, sta in Friuli, a noi rilascia grandi cortili e strade dove giocare libera con gli amici e grandi aie in concerto di voci intonate dai suoni di fronde del vento, le prime note ci giungono così: "*Una ragazzina lancia il suo cavallo al galoppo, lungo la strada abitata da cani felici e galline filosofe, al seguito, la loro nidiata… dove il tempo esiste, lo guardi passare… dilata il tuo io…*".

Clara figlia di Vilma che in una visita alla nonna s'imbatte nello sguardo di Alfredo, giovane bello e dall'accento francese. E sarà un amore contestato da entrambe le famiglie, quella di Vilma con padre in rosso stendardo che comizia gli operai in vari paesi, quella di Alfredo, religiosa, ogni domenica per primi in chiesa e stendardo in prima fila ad aprire la processione. Come Romeo e Giulietta nel tempo di Don Camillo e Peppone. L'amore vince in un più stretto abbraccio e silenziosi in gran segreto vanno a nozze alle sei di un freddo 12 gennaio, perché nessuno vedesse e solo il prete consacrasse. Nasce così Clara, il 4 agosto, in piena estate, nel lettone che dividerà per un po' con mamma e papà, attenti ai lati a lasciarla illesa a dormire. E nasce alle sei del mattino quasi a doppiare nell'ora del loro "sì", ogni anno l'evento.

Lasciamo che l'infanzia corra veloce tranquilla e brava a scuola la troviamo però non nella direzione della sua domanda... Ribalta la situazione e tosta come solo i friulani sanno essere impegna tanti altri libri, affronta gli esami di maturità, s'iscrive all'università di Padova e lì ancora oggi insegna agli allievi cosa sono sinapsi e il neurovedere.

La storia ci dice di un matrimonio di ritorno dal Belgio e da Londra. Nasce la cosa più bella; è che è bella davvero, Anna con cui fa lunghissime chiacchierate, oggi anche Dottore. E arriva Luciano che del vedere è la luce dei suoi occhi e anche le controlla il cuore. Da tanto insieme fanno coppia? Coppia no, che sottrarrebbe o aggiungerebbe una parte pensata mancante per fare come la luna, dopo ventinove giorni e sei ore, luna piena. Nessuno manca di niente. Dispongono del talamo l'intero. Per fare insieme.

Anna ci dice di quanta creatività è intessuta la mamma. Ci racconta di un presepio fatto con pezzi di legno ritagliati da mestoli da cucina, il manico per fare Gesù che poi con pennarelli colorava occhi naso e bocca che somigliasse a un viso, un po' di cotone a tenerlo in culla nel morbido leggero e lamine incastrate con pezzi di legno per il bue e l'asinello, in una stanza con carta dipinta... Chissà se in scia di traccia ritrova lattante la stanza dov'era nata, per soffitto carta bianca tenuta ferma da puntine perché non si vedessero i coppi del tetto tra le travi.

"*Provate a darle una stanza vuota*", dice Anna. Usa gli occhi per vederne lo spazio ma non è l'occhio che vede.
La traccia famigliare l'ha volta sul concetto del bello, forse sarebbe stato un ottimo architetto.
Una stanza vuota, occasione di compiere il sogno. Ne vede subito ogni dettaglio, ogni oggetto mai per caso, mai banale, ciascuno deciso sull'idea di bellezza. E così, come la sua casa, ci porta all'unicum, al suo pensiero in movimento. Dove lo "pesca"?

Correndo correndo, Clara corre, scarpette di gomma, all'orecchio la musica, e dopo… la pastasciutta. Tanta, quanta ne mangiava papà. Un asterisco. E mamma ci dice che aveva sempre fame, sempre affamata, chissà di quale sapere, eppure magra, ci dice: "*C'è miseria de mangià*". Questi i semi… Creativa e scientifica… Per risolvere problemi ed elaborare dati. E poi lei quasi si estranea nel suo ritmo che sbalza quello della sala… lei muove i piedi che sembrano piccoli saltelli, ci inganna, non è la musica della sala che lei ascolta. Altra la sua musica con cui ritma trasognata l'essere felice.

Clara, dove sta l'Altro? L'altrove? Il Dinanzi?

Mi scrive:

"*Nettuno mi scrive una lunga lettera con inchiostro d'ombra e il foglio lucido e trasparente le inghiotte e le risputa, liquidi, ai miei occhi.*
Una voce rotonda con parole straniere all'umano ripete la simile semantica del dolore e del piacere, spettatore il cielo attraverso la lente sfuocata della tamerice con le sue fronde servili al mare.
Spettatore, incanto d'amore e di rimpianto".

Le rispondo:

"*È una mattina dove il sole indugia a mostrarsi.*
Il cielo ha squarci leggeri di azzurro come un lenzuolo che indugia a spostarsi e lascia che sia il
canto dell'amore a tenere stretta la vita, nel pensiero il sogno della pagina bianca che, dinanzi, invita alla scrittura dell'avvenire che non è domani ma, nell'essenziale dell'istante"

Il mare… l'oceano, sempre l'onda perpetua il suo moto.
A chi l'ascolta porta il quaderno dinanzi della famiglia come traccia in scrittura costante mai la stessa, e il ricordo in arenile evapora la sua idea.
Lì nell'arenile nel bagnasciuga orme di piedi in passi sfumano la propria storia. Il sole è già alto, non c'è movimento di foglia. Il silenzio è totale… quasi in attesa di scrittura, di lettura, di svolgere il programma, come a teatro, nei momenti che precedono l'apertura del sipario… eccoci in scena, oggi si recita a soggetto. S'immagina l'evento, qualche anno fa lo si attualizza lo si interpreta con la propria storia, ciascuno nel punto in cui si trova nella ricerca non smette d'inventare, di dirigere il verso in cui l'inedito dell'ascolto direziona.

Oggi Clara c'è il canto delle tue cicale, in àmaca, tra rami d'ulivo secolare, dei grilli, l'odore della terra assolata, l'odore dei fichi d'India, il terrazzo dove immergersi tra specie arbustive di macchia mediterranea, piante perenni, siepi sempreverdi e fiori variopinti… perché altra storia si va ricombinando.

Poesie per Clara

di Forcella Maria Chiara

Conosco delle barche

Conosco delle barche
che restano nel porto per paura
che le correnti le trascinino via con troppa violenza.
Conosco delle barche che arrugginiscono in porto
per non aver mai rischiato una vela fuori.
Conosco delle barche che si dimenticano di partire
hanno paura del mare a furia di invecchiare
e le onde non le hanno mai portate altrove,
il loro viaggio è finito ancora prima di iniziare.
Conosco delle barche
che tornano sempre quando hanno navigato.
Fino al loro ultimo giorno,
e sono pronte a spiegare le loro ali di giganti
perché hanno un cuore a misura di oceano

Conosco delle barche ("Je connais des Bateaux") è una suggestiva e commovente canzone della cantautrice francese Mannik (Marie Annick Retif) dedicata a Jacques Brel. Tratta dall'album "Le temps de l'amour " (1977), i suoi splendidi versi inducono profonde riflessioni sul coraggio di affrontare il "mare" della vita.

Amo in te

Amo in te l'avventura della nave che va verso il polo,
amo in te l'audacia dei giocatori delle grandi scoperte,
amo in te le cose lontane,
amo in te l'impossibile,
(Nazim Hikmet poeta turco costretto all'esilio)

Cucinata di poesie

Si cominciò con un aperitivo
a base di Majakowskij e Proust
si proseguì con un antipasto di Verlaine e Rimbaud
accompagnata con una leggera imbottitura di Baudelaire
che si scontrò con il sapore d'amore
di Garcia Lorca
sopra il tutto una spolveratina
di Prevert.
Si terminò con un Quasimodo alla Montale
e un Cardarelli alla Ungaretti.
E infine fu portata una macedonia a base di
antica lirica greca e cinese
e si concluse con un dolce a base
di sonetti di Shakespeare, Brecht e Pavese
e ci si leccò con il Baffo.
Tutto fu annaffiato
con vini all'incrocio Manzoni

Forcella Maria Chiara (omaggio ai nostri convivi gaudenti letterari e poetici)

Il Nostro Friuli

di Mirella Casco

Il nostro Friuli,
contadino, operaio, costruttivo, silenzioso.
Le donne friulane, nostra madre,
granitiche, determinate, lavoratrici.
Gli uomini friulani, nostro padre,
concreti, fieri, pronti alla fatica per uno scorcio di futuro.
Immagini, ricordi, riflessioni,
di un'infanzia che non ci abbandona.

Mirella

Grande Frutute dagli Occhi Blu

di Luciano Daliento

Se Clara non avesse deciso di dedicarsi alla ricerca e all'insegnamento sarebbe stata un valente ed ascoltato capomastro: siamo insieme da più di 20 anni, abbiamo ristrutturato 2 case e la sua costante presenza durante i lavori erano gioia e dolori per gli addetti ai lavori: chiedeva interventi che all'inizio lasciavano interdetti, ma realizzati, lasciavano tutti soddisfatti. Questa sua capacità è in parte geneticamente determinata, essendo stato suo papà un impresario edile. Immaginazione e costanza nel realizzare un progetto sono, tra le tante, le qualità che più apprezzo ed invidio a Clara. Adora suo nonno, primo comunista di Martignacco, paese che le ha dato i natali, che, bambina, la portava sul carro al mattino presto nei campi, parlandole del mondo contadino, così duro, ma ricco di valori sui quali non si poteva scendere a compromessi. Da lui ha appreso che ogni traguardo può essere raggiunto se si ha costanza e si è disposti a lottare. Un rammarico di Clara è non aver avuto un curriculum scolastico tradizionale e ancora oggi passa ore a studiare testi di storia, per colmare presunte lacune scolastiche, rimanendo l'ultima paladina del congiuntivo. Pur essendo vissuta 3 anni in Inghilterra e ottenuto là il suo dottorato, è completamente priva di humor; non sperate inoltre che possa ridere ad una vostra "joke": la barzelletta non fa parte del suo corredo genetico. Di conseguenza è un po' permalosa e ciò rende piccante il nostro rapporto, considerata la mia natura "relativista" (sua definizione) meridionale. Eppure non ho conosciuto nessuna "nordica" che ami il sud come Clara e che dal sud venga tanto riamata. Devo a Clara se sono tornato a casa a ritrovare le mie radici, i miei antichi amici; è stata di Clara l'idea di avere una nostra casa al sud, ristrutturando un antico trullo, che nel tempo si è allargato per poter ospitare tanti nostri amici. Grazie Clara per avermi ricordato che non esiste soltanto la Cardiologia, ma tante cose importanti e meno importanti che fanno ricca la vita come il ballo liscio, il teatro, discutere di cose fatue aspettando l'alba.

La Mia Mamma, una Donna Coraggiosa

di Anna Marcer

Io ho una mamma coraggiosa.
Una mamma indomita e fiera.
Elegante.
Una donna invincibile che mi sorprende,
mi meraviglia e mi ispira,
che stimo e che ammiro,
che non si lascia fermare né abbattere.
Generosa e bella,
crede negli altri e crede in me.
Sono fortunata.
È una Scienziata.
Ama la logica e il razionale,
il lavoro e le sfide continue,
l'evoluzione della mente dell'uomo.
Mi ha insegnato a ricercare il nuovo e il difficile, il lontano e il diverso.
Come ha fatto lei.
La soddisfazione della sfida di rendere facile l'impossibile,
che diventa quindi vero.
È così che si scalano le montagne.
La mia mamma non mi ha mai permesso di pensare che non potevo fare quello che volevo.
Ne mi ha autorizzata a non diventare ciò che volevo essere.
Ha riempito la mia casa di quadri e la mia vita di amore.
Ho messo la testa tra le sue braccia per piangere e lei ha cambiato la mia prospettiva,
facendomi desiderare ogni giorno di assomigliarle.

«Quattro decenni di insegnamento e di ricerca sulla percezione visiva. Tanto è durata la stagione accademica durante la quale Clara Casco ha svolto il suo compito con una dedizione e un rigore ammirevoli. Alcuni fra coloro che sono stati suoi collaboratori – qui ne sono rappresentate tre generazioni – hanno voluto esprimere con una raccolta di saggi la gratitudine e l'impegno a continuare il suo lavoro. Insieme agli amici che l'hanno accompagnata in questa lunga e fruttuosa stagione sono stati ricordati alcuni momenti importanti di vita e di studio».

978-88-6938-314-4
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