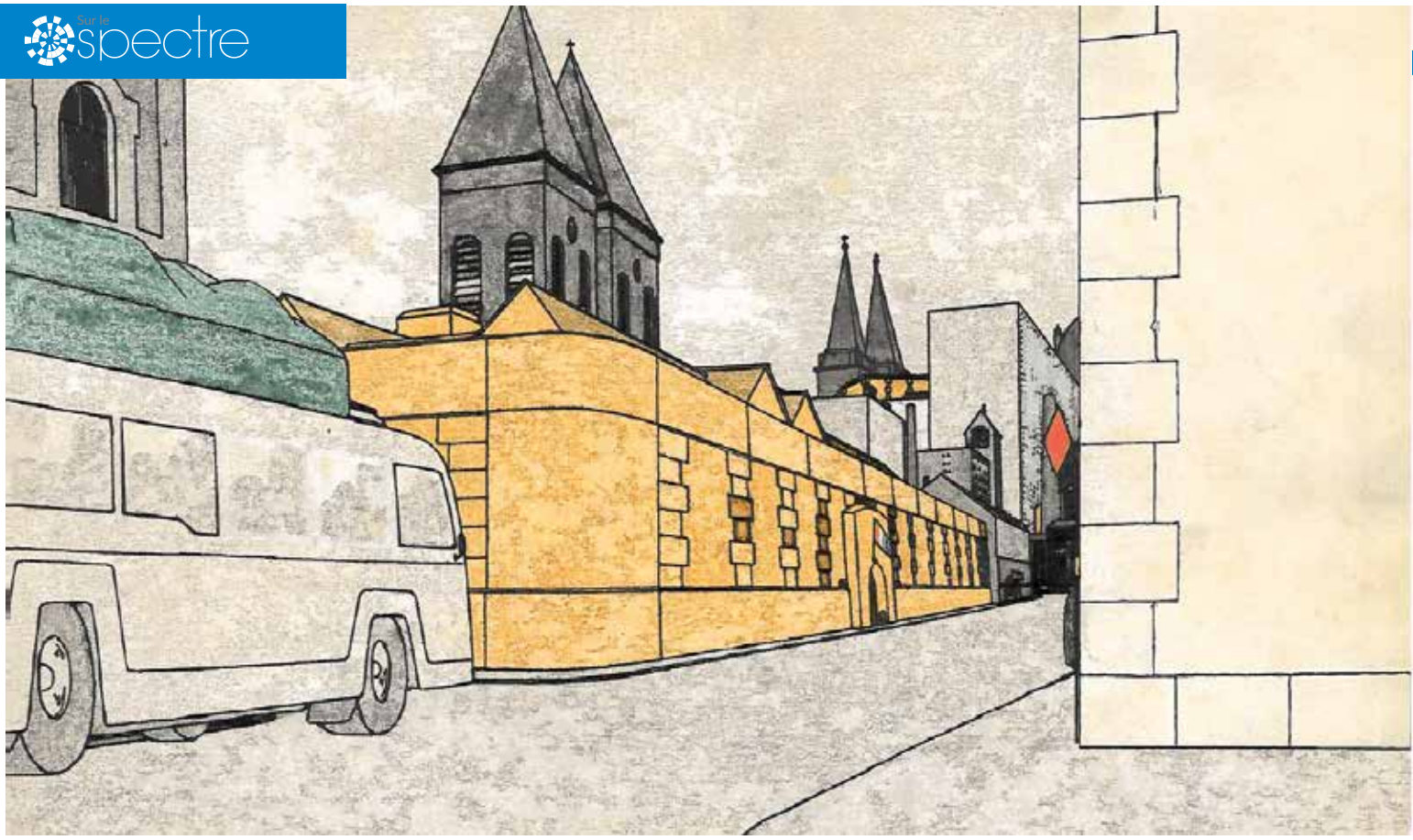

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These models are inspired by Bayes' theorem in statistics, which makes it possible to calculate the probability of an event occurring while taking into account data from events that have already taken place.

Historical Perspective:

From a Case Study to Bayesian models, How do Autistic People Perceive Their Environment?

By**SOPHIA DRAAOUI**

We are offering a brand-new series of articles that will provide a better understanding of how certain key studies have influenced the course of autism research, and by extension, our understanding of autism. The first article in this series focuses on the evolution of our understanding of perception in autism. .

1993: A Case Study

Thirty years ago, researchers Laurent Mottron and Sylvie Belleville published an in-depth case study of an autistic man, EC, with exceptional drawing skills. EC is an autistic savant: he has particularly high skills in one specific area, namely drawing, and the ability to memorize visual information in three dimensions and then reproduce it graphically. When he draws, EC does not make any erasures, even when he is asked to copy images that are optical illusions, and he never uses an eraser. He also does not use shades of color in his drawings but uses mostly pencil and solid colors.

Observations and Results

The goal of this case study was to assess, using several tasks involving perceptual processing and the reproduction of images or objects, whether EC's performance differs qualitatively from that of typical people. Thereby, allowing us to understand how he processes the visual information presented to him, and how this may explain his prodigious abilities.

The researchers asked EC to perform a first series of experiments measuring the ability to analyze 2-D images, to represent, recognize and name 3-D objects, and to color images representing everyday objects. Almost all the results obtained in this first set of tasks were similar to those obtained by the control participants, except for a partially inadequate use of colors. To simplify this, his perception was normal.

EC was then exposed to a second series of tasks aiming to evaluate how information contained in an image is hierarchized in his brain: what is processed the most, or first, in an image. The goal was to observe if EC perceived primarily the details or the general shape of an image. At the beginning of this study, the hypothesis was that autistic people would prioritize details, or the local level, while neurotypical people would prioritize the general form of an image. The researchers found that when the information presented was congruent at the local and global levels (for example, a large letter "C" made up of several smaller "c" letters), then EC responded in a similar way to neurotypical participants: he responded more quickly to the global form similar to neurotypical people. In contrast, when there were discrepancies between the letter represented by the global image and its component details (e.g., a large "C" made up of small "O" letters), EC, unlike neurotypical individuals, did not show a global-level interference effect in his local response. The authors concluded that he prioritized information at the local level, thus the perception of details.

Hypotheses

Based on the results obtained in the different experiments offered to EC, and also drawing on their general knowledge of autism, the researchers suggested several hypotheses on the possible influence of this difference in the prioritization of information on certain behaviors or skills in autistic people.

First, these observations indicate an atypical hierarchy in the analysis of local and global information in EC. This result, obtained in a neuropsychological task, is consistent with what the researchers observed when he draws: he draws the features contiguously, detail after detail, rather than drawing the overall shape of the object and then adding the details later.

The priority perception of details could explain why autistic people perform better than neurotypical people in solving certain puzzles or in tasks where a hidden figure must be located in a complex image. In the case of EC, it could also explain why he is less sensitive to optical illusions.

There could also be more abstract impacts of this prioritization of detail perception. Indeed, the particular perceptual processing observed in EC could perhaps explain his difficulties in understanding humor or in logical reasoning tasks. More generally in autistic individuals, this difference in their perception of the environment could also have an impact when planning an activity in which a succession of small tasks (local level) must be planned in order to achieve a more general goal (global level). A mismatch in detail between the successive small tasks that the person has anticipated and what is actually happening could then disrupt the sequence and lead to an interruption of the activity.

Following the publication of this case study, several hundred articles have studied how autistic people perceive their environment and fundamental differences could be confirmed.

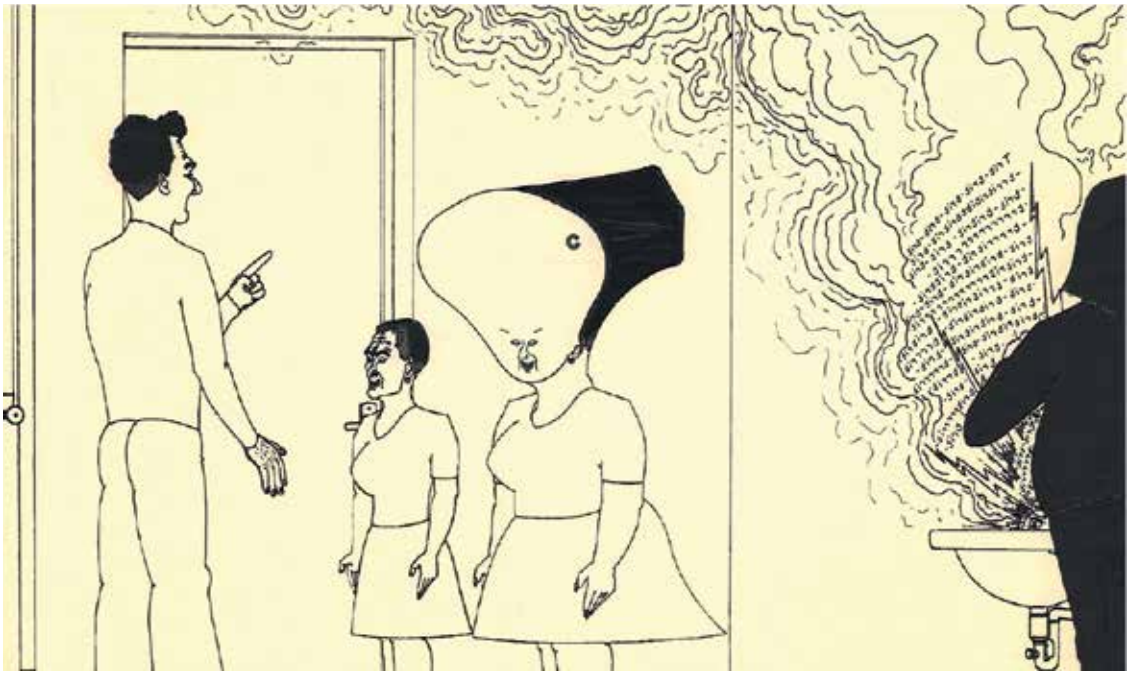
Today: Bayesian Models and Autism

What are Bayesian models?

These models are inspired by Bayes' theorem in statistics, which makes it possible to calculate the probability of an event occurring while taking into account data from events that have already taken place. This is what is used, for example, to detect fraud on your credit card based on your usage habits.

Bayesian models are used today to describe how prior knowledge and expectations influence the processing of information present within the environment, and how these expectations are formed according to the greater predictability (or volatility) of this environment. According to this model, when put in a new situation, a neurotypical person relies significantly on their past knowledge and experience to interpret the data of this new situation. This allows them to be more ef-

Autistic people would therefore look at the world more as it is, making them less sensitive to optical illusions resulting from our "expectations" about the world.



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fective in interpreting the new situation, and to be able to predict what will happen more accurately or quickly.

However, this can also result in a bias in the perception of the new situation. For example, a person interviewing for a job similar to others in the past may expect to be asked the same questions, that there will probably be a Human Resources person present in addition to the future employer, that the interview will last a certain amount of time, etc. His or her predictions may be wrong, or it could be that his predictions are correct and that relying on his past experiences is reassuring and effective. On the other hand, it is also possible that she relies too much on this information and omits relevant information in her preparation.

Application of Bayesian models to autism

In autistic people, the Bayesian hypothesis can lead to contradictory predictions. For some, it predicts that the influence of previous experiences on perception would be less important. Their perception of the situation would therefore be less likely to be biased by their prior experiences. Thus, they would give more weight to perceptual signals. Autistic people would therefore look at the world more as it is, making them less sensitive to optical illusions resulting from our "expectations" about the world. The less weight given by the autistic person's brain to prior knowledge when interpreting their environment could result from a greater influx of information (or details) from their environment, which could explain the sensory overload often reported in autism.

For others, the difficulty lies in the excessive accuracy of their predictions. This could explain the need for predictability in autistic people and the discomfort generated by change since they cannot manage the discrepancy between what they predict from their past experiences and what happens in reality. Thus, since they have more difficulty in finding the right level of accuracy in predictions about their environment, each situation can bring a sense of novelty and insecurity that can lead to significant discomfort.

A final word

This first article in the historical perspective series shows how certain studies, such as the case of EC, are able to highlight important phenomena in autism, and subsequently lead to numerous research and discoveries in the field. It has contributed to a variety of theories of autism, each of which attempts, with varying degrees of success, to account for a particular aspect of autism.

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