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# The lived experience of thinking in pictures in self-declared autistic adults

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## **Abstract**

Thinking in pictures is a distinct cognitive style characterized by the dominant use of visual thinking. Temple Grandin's autobiographical account is the best-known description of visual thinking but there are few first-person accounts of this inner experience. The aim of this paper was to gain further insight into the lived experience of a “thinking in pictures” cognitive style among autistic individuals. To do so, we used qualitative methods to analyze self-reported descriptions of visual thinking by individuals with self-declared ASD. Results indicated that people who reported a visual cognitive style described a phenomenology and a cognitive style that closely paralleled Grandin's. However, many individuals also reported verbal communication issues related to this visual cognitive style. These results allow us to better characterize this particular cognitive style, and also to better understand its involvement in learning situations and social interactions.

**Keywords:** thinking in pictures, self-reported description, self-declared ASD, qualitative analysis, communication difficulties

“Thinking in pictures” is a distinct cognitive style characterized by the predominant use of visual thinking and mental imagery to make sense of and engage with the world. Although thinking in pictures is not restricted to autistic people (e.g., Bled et al., 2021), it has traditionally been discussed in relation to autism and has served to raise awareness of cognitive diversity. While several findings in the literature support this cognitive style in autism, there are few first-person accounts of this inner experience. The aim of this paper was to gain further insight into the lived experience of a "thinking in pictures" cognitive style among autistic individuals.

Several empirical findings have been taken as support for a "thinking in pictures" cognitive account of autism (Kunda & Goel, 2011). For example, studies on the integrity of inner speech (i.e., the little voice in one's head involved in many cognitive functions; for a review see Perrone-Bertolotti et al., 2014) in autism seem to demonstrate the use of non-verbal strategies. In dual-task situations, preventing the use of a verbal strategy by articulatory suppression had no significant impact on the performance of people with autism compared with typical people (Wallace et al., 2009; Whitehouse et al., 2006; Williams et al., 2012). Other behavioral findings suggest that autistic individuals tend to rely more on non-verbal (potentially visual) strategies than neurotypical individuals: for instance, they exhibit difficulties in a verbal problem-solving task (Alderson-Day, 2014), a smaller word length effect during a serial recall task (Whitehouse et al., 2006), but intact comprehension in language tasks involving a visual component (Kamio & Toichi, 2000). Additionally, enhanced visuo-spatial (Muth et al., 2015) and mental imagery abilities (Falter et al., 2008; Pearson et al., 2015; Soulières et al., 2011) in autistic participants have been reported. Furthermore, some neuro-imaging results indicate the enhanced involvement of posterior and parietal brain regions when autistic individuals process verbal content (Kana et al., 2006; Sahyoun et al., 2010; Samson et al., 2012), or solve complex problems, such as matrix

reasoning (Simard et al., 2015; Soulières et al., 2009), suggesting that autistic individuals rely more on visuo-spatial strategies.

It remains unclear, however, whether the empirical findings above accurately capture the day-to-day inner experiences of autistic individuals. This has prompted several studies to adopt a more direct approach. In a questionnaire-based study, Bled et al. (2021) asked a group of autistic and neurotypical adults about the nature of their mental representations in various common real-life situations (e.g., decision making, problem solving, planning). Autistic participants reported a more frequent (but not necessarily exclusive) use of visual mental representations across the situations compared to neurotypical individuals. The authors noted, however, that in the autistic group, some participants never reported the use of visual mental representations, relying instead on verbal strategies only. In another study including neurotypical adults only, Orm et al. (2021) found that participants with AQ scores falling within the broad autism phenotype reported thinking more in mental images than participants showing no or few autistic traits, but that they nevertheless think more with inner speech. These results echo somewhat those of Hurlburt et al. (1994), in which three autistic participants described the content of their inner experiences over several days. All three participants reported thoughts primarily or exclusively in the form of mental images. More recently, using the experience sampling methodology, Hare et al. (2015) noted that the autistic group reported more thoughts as images compared to the neurotypical group, whereas the occurrence of inner speech was similar across groups. Although these results are consistent with a predominant / more frequent use of visual mental representations in everyday situations, at least in a subgroup of autistic individuals, they do not offer a comprehensive understanding of the subjective experience associated with a "thinking in pictures" cognitive style in autistic people.

The value of first-person narratives (i.e., autobiographical accounts) in autism research has been increasingly acknowledged in recent years (Caldwell-Harris et al., 2023; Jaswal & Akhtar, 2019; Trevisan et al., 2017). Such narratives are typically produced and shared publicly to express personal experiences and perspectives with no predetermined research objectives. They offer invaluable insights into the lived experiences of being autistic and can shed light on important aspects of autism that have not yet or few been explored.(Dinishak & Akhtar, 2023; Welch et al., 2022).

Thinking in pictures is perhaps best known through Temple Grandin's autobiographical account (Grandin, 2006). In her book, "Thinking in pictures: my life with autism", as well as in various interviews, articles and presentations, Temple Grandin, an autistic researcher and author, provides an in-depth account of her way of apprehending the world through visual thinking. Although her visual cognitive style is sometimes experienced as a strength, as in her work in designing equipment for livestock ("Every design problem I've ever solved started with my ability to visualize and see the world in pictures" p.4), it also presents a number of challenges, such as comprehending abstraction ("As a teenager and young adult I had to use concrete symbols to understand abstract concepts" p.17). Her account makes it clear that thinking in pictures impacts various dimensions of her daily life.

### *The present study*

The primary aim of this study was to gain further insight into the lived experience of a "thinking in pictures" cognitive style among autistic individuals. We collected and analyzed first-hand narratives shared by self-declared autistic individuals in the form of written posts on a popular website hosting an online discussion forum. By using forum discussions as a source of first-hand accounts, our objective was to collect a variety of experiences to capture the nuances,

challenges and strengths associated with thinking in pictures. We performed a qualitative analysis of the content of the posts in the light of Temple Grandin's account about her visual thinking.

## **Methods**

### *Study design*

We used a directed content analysis approach to investigate the contents of online discussion forums pertaining to a visual cognitive style among individuals who self-identify as autistic. The directed approach to content analysis is a systematic method that involves the use of predefined coding categories to guide the analysis process (Hsieh & Shannon, 2005). In this study, the predefined coding categories were derived based on the narratives provided by Temple Grandin regarding her personal experience of "thinking in pictures".

### *Data source, collection and cleaning*

First-hand accounts were collected from WrongPlanet.net, a publicly accessible website that hosts online discussion forums and that gathers more than 80,000 registered users, the majority of whom self-identify as autistic. The following keywords, '*thinking in pictures*' and '*visual thinking*', were entered in the website's search query box. A total of 25 discussion threads were selected from the returned lists based on the relevance of their titles with respect to the research question (e.g., "What is it like to think in pictures?", "Do autistic people think in pictures?"). Thread posts were automatically extracted from the WrongPlanet website and organized into a spreadsheet, where each post was arranged in a single row, along with the user's gender and age when available. The 25 threads yielded a total of 888 separate posts from 504 independent WrongPlanet users. Next, a thorough review of each post was conducted (L.B and Q.G) to exclude posts that did not describe the personal experience of thinking in pictures. This selective process involved identifying and filtering out posts that were 1) not aligned with the topic of interest, 2) minimal contributions, 3) mere factual statements lacking

experiential narratives, or 4) focused on the experience of an alternative cognitive style (e.g. verbal thinking) or difficult to determine. The final corpus comprised 101 posts from 77 independent users (age  $M = 42.3$ ,  $SD = 12.2$ , women = 45, men = 26, NA = 6). The corpus was uploaded into MAXQDA software for further analysis.

### *Ethical considerations*

We contacted the site administrator about this research and, in accordance with their instructions, we informed the community about this research by posting a message on the forum. We explained the purpose and the methodology of the study and indicated that members could contact us to withdraw their posts from the data collection, which nobody did. We did not collect user-names to preserve confidentiality and anonymity. Instead we attributed a code to each user to identify their contributions (indiv1 to indiv77). This research obtained the approval of the Research Ethics Committee of Toulouse University (project ID 2023\_762).

### *Data analysis*

Prior to data analysis, a code-book was developed based on Temple Grandin's first-hand account of her visual cognitive style and how she describes it. L.B developed the code-book, which included codes and their operational definition (see supplementary data).

A line-by-line coding approach was adopted to first identify segments of posts that corresponded to the predefined coding categories. Inter-coder reliability was reached through regular meetings to discuss and compare coded segments, resolve discrepancies and discuss codes emerging in the corpus that were not part of the initial coding scheme. These new codes were intended to categorize segments of posts that could not be coded using the predefined codes but were deemed relevant to the research question. This process resulted in 199 coded segments. The resulting codes were next grouped and organized into higher-level categories based on their thematic similarities. The final themes and sub-themes are described in the results section along with illustrative quotations.

## Results

Our analysis of the personal experiences of thinking in pictures revealed 3 main themes and 10 subthemes (see Figure 1). Each theme and subtheme will be described below. Direct quotations (italicized) are incorporated throughout to exemplify each subtheme.

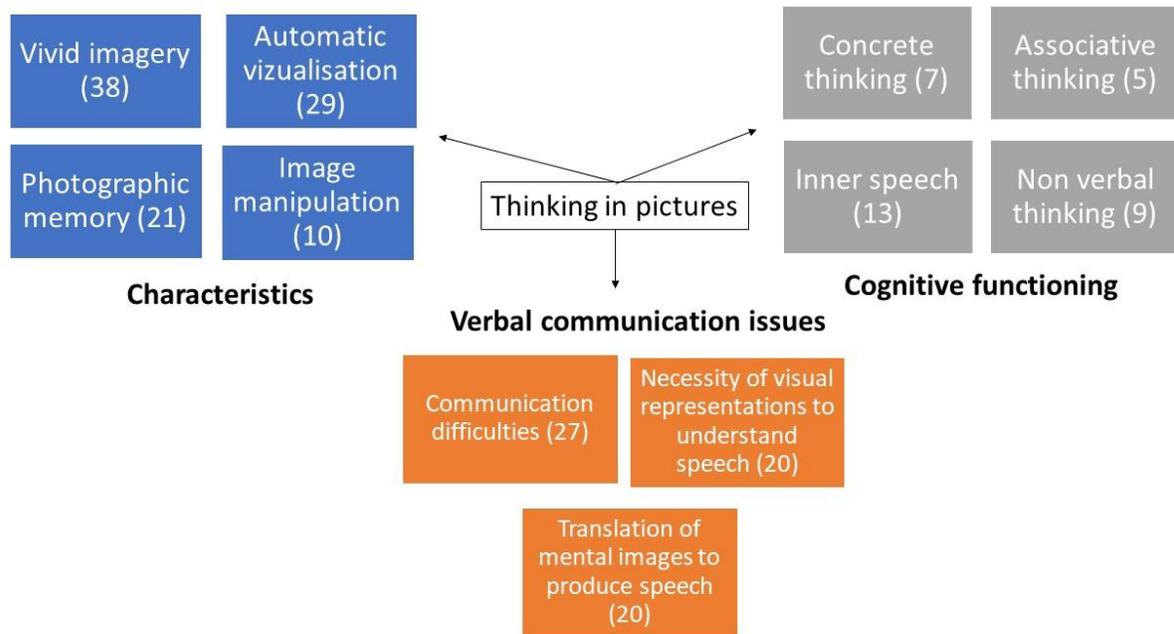


Figure 1. Main themes and subthemes related to thinking in pictures. Numbers in brackets indicate the number of coded segments in each subtheme.

### **Phenomenological characteristics**

This theme was defined as “phenomenological description of the ability to think in pictures”. This theme included subthemes related to: 1) vivid imagery, 2) automatic visualization, 3) photographic memory, and 4) manipulation of the mental image. The data on this theme largely corroborate Temple Grandin's description of her visual cognitive style, but also highlight other aspects.

### **Vivid imagery (n = 38)**

Many people reported the ability to generate highly detailed and accurate mental images. They described their mental images as dynamic, as in videos.

*“I visualize as if I’m inwardly seeing something.”* Indiv1

*“I think in crystal clear 3D images and videos.”* Indiv67

For some of them it also involved a **multisensory dimension**.

*“In addition to pictures, I also have a lot of sensory things from sound, touch, smell, taste going on in my mind at the same time that I think visually to figure things out.”* Indiv21

*“To recall yesterday, its a bombardment of different images, (like as in video playback) also smell, sounds. All my senses contribute, mainly my visual ones”* Indiv23

This vivid imagery can be **overwhelming** and can take up space in the visual field. Difficulties maintaining contact with the outer world are reported.

*“I also think in pictures - thousands and thousands, which often take precedence over the material world.”* Indiv75

But for some others, the ability to distinguish inner perception from the real world remains intact.

*“I can vividly see my thoughts it pictures while simultaneously being able to see the realistic world around me. Both are equally as vivid, but I can distinguish between what is thought and what is reality no problem and I can tell which one is coming from inside my head--I see them two different ways.”* Indiv44

On this other hand, this capacity to visualize can help to apprehend and to **perform mathematics**.

*“Math would be a good example. I have to see the things I am solving and get the picture. Then cut it up and rearrange it into something coherently extrapolatable. Shapes, numbers and arrangement is all a visual construct”* Indiv72

### **Automatic visualization (n = 29)**

The visualization of the vivid mental images triggered by a heard word or a thought is automatic, it cannot be controlled.

*“I automatically see a picture of what something is, rather than explanation in words.”*Indiv14  
*“If someone tells me "it's cold so I'll be wearing a coat", I instantly have a picture in mind of them wearing a coat. The images just appear in my mind, it's not a conscious thing.”* Indiv 32

This automatic visualization can also take the form of **written words**. This phenomenon has been described as the ticker tape experience (Chun & Hupé, 2013).

*“I'd often visualise my thoughts as writing on a chalkboard, or on a typewriter. As I'd think something, it would be 'written' or 'typed'.”* Indiv22

*“I think in pictures, but I also see all of my words in my head as though they are on a scroll bar.”* Indiv 43

The main activity cited as an example of this ability to visualize automatically is **reading**:

*“And when I read silently, I "hear" the words in my head and have extremely intense visualization. Almost every word or sentence I read is transformed into an image or a scene.”*

Indiv6

*“When I read, I watch movies in my head. They are in color. I watch the main movie on the left side of my head and the details of the little things in the movie on the right side of my head.”*

Indiv21

### **Photographic memory** (n = 21)

Many people reported a photographic memory which can be defined as the ability to remember and recall information with exceptional details, akin to photographic images or videos:

*“My memory works the same way, to the point where it is almost like having a little television in my head. If I'm having trouble remembering things I can essentially "track back" like one would with a video tape. To test this I once sat down for a few hours and went back through the entire month, and I was quite amazed at the level of detail I was able to remember”.* Indiv62

*“I do have the photographic memory thing, I can purposely recall it and I can see it exactly in color and detail, and movies are like a series of stills they don't really move like a movie unless I kinda flip through the snapshots quickly, or cut to a scene and it moves like a short clip. with*

*sound in fact that is how I remember verbatim conversations, or events, I play or rewind to that point and play until I get it all recalled, it helps not to be agitated or otherwise peed off, because you can slow down and get more detail.”* Indiv 7

This photographic memory can help **for spatial orientation**.

*“I have discovered that if I study a map for a while, it "imprints" in my head. Later when I am lost, I call up the map in my head, orient myself to where I physically am in relation to the map then I can figure out where I am and where I need to go. I can also zoom in and zoom out. Honestly, it looks like having MapQuest in my head (or whatever "get directions" website you prefer).”* Indiv18

It can also help to respond to certain tests at school as the textual content is “photographed”.

*“When I memorize things for school, I use charts and pictures from the textbooks. When I take the exam, I can pinpoint the exact location on the chart or textbook in my mind that relates to the specific question if I am familiar with it.”* Indiv30

### **Mental manipulation (n = 10)**

Some individuals reported the ability to manipulate mental images by rotating them in different directions, such as viewing an object from various angles, positioning oneself above or below it, and rotating it simultaneously

*“In this I will have an image of an object. I can zoom in, remove or hide pieces of the object, and view from any angle. I can also see cutaway views. It is very similar to a CAD program.”*

Indiv58

*“I can visualize objects and rotate them in my mind much like one would in Google SketchUp or similar.”* Indiv46

This ability to manipulate mental images can help to perform **mental simulation** in which individuals engage in thought experiments of mentally trying out or testing ideas, concepts, or machine designs without the physical construction of the object.

*“If I have something mechanical, I take apart, I look at all the pieces, put it together in my head, and I have a working model. I can see things work, before they actually ever do. If I need to*

*problem solve, I can take the different things in my head, and kind of put them in a family tree type looking thing, until I come up with the correct conclusion”* Indiv71

### **Cognitive functioning**

This theme was defined as “the description of general cognitive functioning related to the ability to think in pictures”. This theme included subthemes related to: 1) concrete thinking, 2) associative thinking, and 3) inner speech.

#### **Concrete thinking (n = 7)**

This subtheme can be described as difficulties in conceptualizing abstract ideas as they rely less on tangible, visible elements.

*“I can think abstractly in certain situations, but it is much more of a challenge for me (certainly not natural).”* Indiv17

*“if I’m thinking about abstract ideas and data, I can’t picture anything most of the time, nor do I see words; it’s just a blank image.”* Indiv34

#### **Associative thinking (n = 5)**

This cognitive functioning is also characterized by a non-linear and non-sequential thinking to connect thoughts. This non-sequential thinking is related to the ability to think in pictures as an evoked image triggers other images which can sometimes take the person far from the topic.

*I also frequently “jump” from one thought to another, switching between the things I am describing, returning suddenly to something I had been talking about earlier, then going forward just as unexpectedly. It happens because I will suddenly feel that something is really relevant and must be mentioned, - usually it’s something that “flashes” especially vividly in my mind’s eye at that moment, - so I will skip to it.”* Indiv33

#### **Non-verbal thinking (n = 9)**

Some individuals reported thinking primarily in pictures and experiencing words as a secondary form of communication, akin to a second language.

*“Language isn't my first language - my inner language is made up of pictures, colours, movement, and concepts (fully formed ideas which are neither verbal nor exactly visual, but are just "there".* Indiv36

*“I can't think in terms of words though.”* Indiv13

### **Inner speech (n = 13)**

Inner speech can be described as internal language, the little voice in one's head. Diverse manifestations of inner speech are reported. Some individuals describe a complete absence of inner speech.

*“I had no inner speech that I could turn on to go with the pictures and videos that were my thoughts”* Indiv21

Sometimes inner speech is just present to comment on the evoked pictures:

*“words and sentences do come up in my thinking processes from time to time, but are always accompanied by images and colours and very much secondary to them”* Indiv36

For others, the presence of inner speech is reported to be part of their cognitive functioning:

*“I guess my thoughts are mostly visual but I can quite often "hear" them too.”* Indiv74

### **Verbal communication issues**

Verbal communication was defined as “the interference of thinking in pictures on verbal communication”. This theme included subthemes related to: 1) communication difficulties, 2) the need for visual representation in order to understand speech) the need to translate mental images in order to produce speech.

### **Communication difficulties (n = 27)**

Many people reported that this ability to think in pictures led to difficulties in communicating verbally with others.

*“Thinking in images is the most incompatible with speech, I could maybe draw something and that would be easier and I need time to switch the mode and describe my thoughts. Wish I could just project my 'mini-films' straight into people's heads or on a screen.”* Indiv60

*“I often feel frustrated with my thinking in pictures, because I feel that I cannot adequately communicate the pictures in words, and I wish that I could just project the pictures out of my eyes for other people to see”* Indiv21

These difficulties can be overcome through **written communication**, as this type of communication gives more time to formulate thoughts.

*“I think I do much better with the written word when describing things, but that might go with what I already said: by scripting or spending time thinking to say the right words.”* Indiv20

### **Need for visual representation to understand speech (n = 20)**

Many people reported that visual representation was necessary in order to understand verbal instructions.

*“If I cannot picture something in my mind because I've never done it before or it totally word-oriented, then I can't understand it at all.”* Indiv29

*“complicated verbal information just passes me by unless I can build a picture in my mind to help understand it better”.* Indiv25

This need to have a visual representation in order to access meaning can pose difficulties at school, where learning is generally word-oriented.

*“In order to learn what a teacher is saying I have to visualize images that represent what is being said.”* Indiv47

*“My teachers like to yell at me for drawing my notes, but it's the only way I'll understand them”*  
Indiv64

### **Need to translate mental images in order to produce speech (n = 20)**

In order to communicate, thus to produce speech, most people reported the need to translate their mental images into speech.

*“It is difficult to translate my thoughts into words for speech and sometimes almost impossible.”*  
Indiv36

*“The big problem with thinking in pictures is translating pictures into words.”* Indiv21

This process of translation is not automatic and requires **cognitive resources**.

*“What is tiring is talking, because I always have to translate images into words.”* Indiv53

*“[...] translating what I “see,” whether that be what I see with my eyes or in my mind, into words, is definitely NOT intuitive, but is rather an extremely intellectual and time consuming process.”* Indiv50

## **Discussion**

The aim of this study was to explore the lived experience of a “thinking in pictures” cognitive style among autistic individuals. To this end, we used a qualitative approach to explore the accounts of individuals, self-identified as autistic, who described this visual cognitive style. The themes that emerged from the data drawn from 77 distinct individuals are related to the phenomenology, the cognitive style, and verbal communication issues. As discussed below some of our results are in line with the description made by Temple Grandin of her ability to think in pictures, especially those related to the phenomenological dimension, but some others, in particular those related to verbal communication issues, shed a new light on this dimension.

In her books, Temple Grandin (Grandin, 2006, 2022) provides an in-depth description of the phenomenology of visual thinking. What emerged from our results is that the phenomenological aspects (vivid imagery, automatic visualization, photographic memory and image manipulation) are frequently mentioned by individuals who reported a visual cognitive style. However, the relative strengths (drawing) and weaknesses (algebra) described by Grandin as inherent to visual thinking were seldom mentioned, and a high variability of skills was

evoked. Interestingly, our results also highlight some other aspects that Grandin did not mention. Some individuals described the experience of the automatic visualization of spoken words, also called the ticker tape phenomenon (Chun & Hupé, 2013). This phenomenon is often associated with synesthesia and its prevalence is estimated at about 7% in the general population. The fact that some of the individuals who reported experiencing a visual cognitive style also experience a ticker tape phenomenon suggests that it might be a manifestation of vivid imagery rather than an isolated phenomenon. Furthermore, some individuals also mentioned how their ability in mental imagery involved in mathematical activities. This observation is in line with a body of research that has evidenced the link between visualization and performance in mathematics (Presmeg, 2020).

In addition to these phenomenological manifestations, Grandin also described the cognitive functioning involved in visual thinking: non-verbal thinking, bottom-up processing, cognitive rigidity, concrete thinking and associative thinking (see codebook in supplementary information). Only non-verbal thinking, concrete thinking and associative thinking were themes that emerged from our corpus, and then only to a limited extent. This discrepancy can be explained by the fact that Grandin undertook an in-depth analysis of her general functioning in the framework of visual thinking, which may not be the case for the individuals whose accounts we have analyzed, and who shared their experience on discussion forums. Regarding inner speech, Grandin reported experiencing it only when narrating images. In our results, inner speech was a sub-theme of cognitive functioning and diverse manifestations were reported, ranging from complete absence of inner speech to presence as part of general cognitive functioning, independent of visual thinking. These results illustrate the diversity of the autism spectrum and

might explain in part the apparently contradictory results regarding the presence of inner speech in autism (Alderson-Day & Pearson, 2023).

The theme that was the most frequently discussed is the verbal communication issues that arise from a visual cognitive style. Individuals reported difficulties communicating with other people due to their visual thinking. Written communication was considered easier since more time can be spent on describing visual images. Conversely, a visual representation is often needed in order to understand adequately what has been said. For abstract concepts, it is often difficult to call up a visual representation, which may explain the difficulties with abstraction reported in our sample. Some individuals outlined difficulties at school, where learning is generally word-oriented. The other main difficulty reported was translating mental images when producing speech, which requires cognitive resources. These difficulties with verbal communication were not highlighted by Grandin. Recently we published a case study of a synesthete who thinks in pictures and reported these difficulties of communication due to the process of translation (Bouvet et al., 2023). We interpreted these difficulties in translating nonverbal to verbal information and vice versa using Paivio's dual coding theory (Paivio, 1971, 2010). This model stipulates that verbal and non-verbal information are processed via two distinct but interrelated systems. The model contrasts with general psycholinguistic theories which presuppose that our mental lexicon, which contains semantic, syntactic, morphological, phonological and orthographic properties of words, is an obligatory passage for all information. The fact that individuals who reported thinking in pictures also reported these difficulties of translation lends support to Paivio's model. Moreover, and above all, these results suggest that a visual cognitive style may contribute, in part, to the verbal communication difficulties reported in autism.

An obvious limitation of this study is that the diagnosis of autism could not be verified. Although WrongPlanet is an online community of autistic individuals, it is likely that not all users would meet the diagnostic criteria for autism. For this reason, the results of this study should be taken as preliminary and further studies with individuals with an informed diagnosis are warranted. Furthermore, the narratives we collected may not provide the same level of in-depth detail as interviews in traditional qualitative studies and the potential for bias in online narratives and the inherent challenges of assessing the veracity of self-identifications need to be considered (Dinishak & Akhtar, 2023). Nevertheless, we regard this exploratory study as a crucial initial step in advancing our comprehension of the lived experiences of individuals on the autism spectrum who possess a "thinking in pictures" cognitive style. It offers a foundation upon which future research endeavors can build to provide a more comprehensive understanding of this unique cognitive phenomenon (Caldwell-Harris et al., 2023).

It also should be mentioned that during our data collection, we found many accounts by individuals who self-identify as autistic but who do not report visual thinking; rather, they reported verbal, pattern, multimodal or undefined thinking. Some individuals also described themselves as aphantasics (i.e., unable to create mental imagery). Thus, visual thinking should not be considered as emblematic of autism since a diversity of thinking exists in this condition, as in the general population (Heavey & Hurlburt, 2008). However, the prevalence of visual thinking in autism might be higher than in the general population (Bled et al., 2021).

To conclude, our results highlight that individuals who reported thinking in pictures reported phenomenological characteristics described by Temple Grandin. Our results also highlight that a visual cognitive style impacts many aspects of daily life such as learning or

communication. Given the methodological limitations of this study, further research might explore these themes in greater depth in order to better apprehend this particular cognitive style.

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## **Contributions**

Lucie Bouvet: Conceptualization, Methodology, data curation, Formal analysis, Writing, Funding acquisition

Quentin Guillon: Methodology, Investigation, data curation, Writing,

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