Visually Informed Accounts: Instructed Achievements during Planetarium Visits and Sky Observations

In this paper we shall explore participants' accounts of visual scenes produced during the instructed work of observing celestial bodies at planetarium sessions and star-parties. We use as examples some interactions in which participants (i.e. guides and visitors) are giving/following instructions and exchanging descriptions about the observed object based on their (in)direct access to the matter at hand and also on their orientation to the world shared in common. According to the materials we analyze, we found that the descriptions of participants' observations produce and complement each other's accounts of the object under scrutiny. This phenomenon helps us understand how the instructed observation work is locally and collaboratively managed, which in turn opens the possibility for us to explore how visual accounts are produced through the sequential and categorial aspects of talk. Such enterprise gives guides and trainers a better picture on how visitors make sense of the contents delivered.

Introduction

In this paper, we shall discuss how sky observations are achieved through the collaborative work by guides and visitors in astronomical observatories, planetariums and star parties – the practical actions of giving/following instructions to identify certain objects in the sky. In other words, we will be looking at how observations are produced from within, i.e. through the collection of instructions given by the guide and the collaborative work (between the guide and the visitors) of transforming these instructions into practice (Garfinkel, 2002; Sormani, 2010; Liberman, 2013), that is, into the practical enactment of 'seeing'. Garfinkel (2002) referred to this collaborative work as 'instructed actions', i.e. actions that 'exceed [their] prior instruction and or subsequent discursive rendition' (Sormani, 2010: 170).

The praxiological approach adopted in this paper allows us to bring the production of instructed actions (jointly produced by observatory guide and visitors) to the fore, since these actions become available to close inspection through videorecorded data generated from interactions into which we are looking. These videorecorded materials constitute what Mehan (1978) called 'retrievable data', i.e. data available for repeated inspection, whereby we can subject the data to increasingly fine-grained analysis. This will make available the 'dark matter of instruction' (Lindwall and Lymer, 2008) or the 'ghost that rules the house' (Liberman, 2013: 140) and help us understand how instructed visual experiences (sky observations, in this case) are accomplished and accounted for in the interactions explored here.

Moreover, we will explicate instructed actions in procedural terms, i.e. how they are accountably and collaboratively achieved in sequential and categorial terms in the interaction. For this purpose, the actions we observe are situated and produced in what Garfinkel (2002) calls 'perspicuous settings', settings in which practices are embedded and also available to be examined, elucidated and taught as *in vivo* work-site accounts. This means that we will be exploring the practical contingencies of visual perceptual accounts, i.e. how they are produced by members themselves, instead of how we, as analysts, formally and theoretically describe them.

Looking at how members themselves produce accounts based on their seeing work helps us answer the following questions:

- Given the constitutive character of language in and for instructed action (Sormani, 2010), how is "seeing work" collaboratively and accountably achieved in talk during planetarium visits and night sky observations?

- What are the other circumstantial particulars involved in the tasks that bring the interactions under observation to a successful accomplishment?

Adapting a claim from Mair et al. (2013: 410), we will be exploring visual perceptual accounts as ‘both an art in itself and one that is contingent on’ guided observations through skilled instructions given by the guide and the collaborative (and discursive accountable) work of following them. In other words, we take the visually available world as any organized activity in which participants not only make sense of objects, but also actions (i.e., talk, movements and instrument manipulation). These elements (i.e. objects and actions), however, are not perceived or accounted in talk as separated entities, as they are tied and coherently arranged in a single contexture, i.e. in a gestalt-contexture and gestalt-coherence mode, which loses its phenomenal integrity if partitioned (Gurwitsch, 1964; Wieder, 1974; Garfinkel, 2002).

Visual Perception and Interaction

Various studies explore visual activities such as ‘observing’, ‘looking’, ‘noticing’ or ‘seeing’ as instructively and collaboratively organized practices, acted out locally along the course of interactions.

Using data gathered in astronomy education environments, Authors (2020 and 2021a), for example, investigated the practice of describing what is being seen to another person, where visitors to an observatory had to describe to guides what they could see through the telescope so that the guide could help them make sense of the celestial body under display. This practice of seeing using equipmental mediation while orienting to the instructions from a professional (what the authors called ‘seeing by proxy') provides us with an illustration of how seeing work is collaboratively produced. Seeing by proxy is a complex of the equipmental mediation of the telescope; a version of what Sacks (1963) called a 'commentator machine', where a visitor describes what they are able to see through the telescope or express wonderment at what they are able to see. Constitutive of seeing by proxy are accounts of what is being seen with the guide providing the visitor with an 'instructed seeing' (Watson and Sharrock, in press). In this way, there is a gestalt configuration to the practice of seeing by proxy, which is characteristic of the astronomy sessions in our data and may be observed, *mutatis mutandis*, in other settings, *e.g*., eye testing (vom Lehn et al. 2013).

Lindwall (2008) explored another case of collaboratively produced seeing with data gathered in a physics lab where students were having problems in finding proper ways to see an illustration of Newton's second law, *i.e.* Force equals Mass times Acceleration, represented in graphs. The teacher then provided the students with proper ways of seeing the graphs by disregarding noise when distinguishing shapes in them. The results in Lindwall (2008) show us how instructed seeing provides unique phenomenal details of practical action when explored from within, since the work of giving instructions and following them in order to see something must be treated as problematic by the participants themselves, not by the analyst.

This adds to Garfinkel's (2002) study on instructions as an Ethnomethodological topic. He reports two cases of people using inverted lenses when doing ordinary things, i.e. 'sitting on a low wall in the backyard' and 'playing chess'. As those people were wearing welder's masks with prisms mounted at gaze level, the position of the scene they saw became inverted. On the first case, a student wearing inverted lenses was being instructed by another without the lenses on how to move along a backyard, lean the body and sit down with the image upside-down. The student reported to listen to her colleague's directions and see him and his gestures pointing to the place where she should sit. However, she could not 'see' exactly where her colleague was, nor the right direction of the point. Garfinkel then suggested that by using inverting lenses we learn that there is a structure in the phenomenal details of practical seeing. When those details are destroyed or lost, the coherence we once had when doing practical and ordinary things in the world become utterly unavailable. The same thing happened in the second case, where a student playing chess with inverting lenses could not see the places where the pieces-in-the-game should go. In other words, the student could not see the 'reasons-for-a-piece' (Garfinkel, 2002: 210). The inverted lenses made unavailable the 'lived present state of the game, the lived possible move, the lived phenomenal details' (p. 211). Those results, according to Garfinkel, help us understand that eyes are not just part of our bodies, but also skills 'in the ways that eyes do looking's work' (p. 210) and 'seeing is something more, other and different than formal analytically describable positioning the orbs to assure certain retinal registration of a perceptual field, let alone a visual field' (p. 210).

The results of the studies reported so far point to a conception of seeing different from a cognitivist perspective, i.e. the light carries information through our retinas to the brain, which produces a seeing of the thing. This means that seeing cannot be conceived as something internally (and passively) processed, since if it is passive, the very achievement in a seeing activity consequently disappears. Sharrock and Coulter (1998) support this critique of seeing as an internally produced phenomenon and go beyond a Gibsonian[1] reformulation of it, arguing that there should not be a pre-

[1] Sharrock and Coulter refer more specifically to James J. Gibson (1966 and 1979).

analytical definition of the term 'see', but an investigation on the ways that seeing is present in the accounts (produced by members) visually available during the activities.

Goodwin (1995) also supports this idea and claims that perception and action are inextricably linked' (p. 256). For Goodwin, perception is not 'located in the psychology of the individual brain', but constituted through 'situated endogenous social practices' (p. 256). This claim is shared by Smith (2019), who suggests that a commentary is not an 'access behind the skull to some kind of cognitive, mentalistic, or neural order' (p. 30). Instead, as Hester and Francis (2003) also argue, a commentary 'reports visual observations that are integral to and constitutive of the activity' (p. 37).

In his professional vision paper, Goodwin (1994) provides another good example on how linguistic and visual practices are intertwined by analysing talk and embodied action in the fields of archaeological excavation and legal argumentation. He argues that seeing is not 'a transparent, psychological process but instead a socially situated activity accomplished through the deployment of a range of historically discursive practices' (Goodwin, 1994: 606). For Goodwin, it is between the interplay of two phenomenal properties that a seeing event emerges; (i) the domain of scrutiny (represented, for example, by a patch of dirt) and (ii) as set of discursive practices, which divides the domain of scrutiny by pointing at a single element (e.g., a figure against a ground) within a specific activity (e.g., mapping a site or planting crops). By analysing the work of archaeology students during activities of field excavation, Goodwin noticed that students learn how to follow coding schemes (the Munsell color chart) that are used as 'objects of knowledge' and 'animate the discourse of a profession' (p. 606). In Goodwin's words, 'all vision is perspectival and lodged within endogenous communities of practice' (p. 606). In these communities there is a historicity of practices that is put into operation when professionals identify common features in their daily work that can be used to provide a ‘texture of intelligibility’ (p. 610) to the object at hand. This texture is used to unify different objects and produce coherence among them. To use an example from our data that will be discussed later, during a sky observation, astronomers also identify common features in their work, i.e. position of different stars in the sky that group them in a same constellation. According to Goodwin (1994), however, sometimes those common features are difficult to see. Therefore, a common practice by astronomers is to use a coding system, e.g. draw a line connecting stars and forming shapes that can be identifiable by visitors as coherent and recognisable objects.

Moreover, it is important to state that we align with Coulter and Parsons (1990) in arguing that the coherence and the recognition in identifying the objects is not theory or concept-laden. In other words, one cannot make fair judgments on what the other knows (or the knowledge the other is acquiring) by observing how the other is reporting what is seen. Visual perception, according to Coutler and Parsons, is an achievement, not a process that can mediate mental representations. The authors (p. 254) use an enlightening example described in Hanson (1961) of the astronomers Johannes Kepler and Tycho Brahe watching the dawn. While Kepler would see the dawn as a consequence of the Earth moving around the sun, Tycho, who believed in a geocentric model of our solar system, would watch the dawn as a consequence of the sun moving around the Earth. However, as Coulter and Parsons also argue, using seeing as a concept-laden phenomenon is misleading since visual perception is not something nomically dependent on a source (theory or concept), but ‘limitless, meaningful and publicly available’ (Reed, 1987 apud Coulter and Parsons, 1990: 259) in circumstances where there is something relevant to be seen.

Another relevant example of this can be found in Garfinkel et al. (1981), who investigated the night's work of two astronomers, John Cocke and Michael Disney, while talking to each other during their observation of a pulsar. According to Garfinkel et al. (p. 140), it is clear from the beginning of the talk analysed that the possibility of the astronomers' discovery and achievement 'inhabits their work from the outset'. However, the pulsar observable to them is not the pulsar 'out there', i.e. as a 'physical' or a 'natural' object, but a cultural object 'situationally conditioned' in the lived presence of the astronomers' experiments (Garfinkel et al., 1981: 140).

In the studies mentioned in this section, visual perceptions and interactions are inextricably tied, which means that participants do not only make sense of what reaches their eyeballs as physical objects, but mainly as cogent and coherent details of their practical and mundane work (Garfinkel, 2002). As seeing is part of our practical and mundane achievements, seeing can produce meanings (Goodwin 2001), not mental representations.

These studies also clarify our emphasis on visually informed accounts. One of the commonalities of these studies with our own data is that visual perceptions are intrinsically linked with and reflexively tied to verbal accounts. The verbal and visual accounts are mutually informing in that the 'talk about an object' informs what is being seen, and the object informs 'what is being talked about'.

Setting

The data used in this study were recorded in Portugal in the Summer of 2019 and Winter of 2020. We partnered with a diverse group of institutions – a science center, an astronomical observatory, a science museum and a private astronomy education company. These institutions periodically organize planetarium sessions and observations of the night sky with school groups and the general public. Our corpus is composed by more than 40 hours of video and audio recordings of these activities and corresponding transcripts. In the analysis section, the transcripts are presented in their original version, i.e., in Portuguese. However, below each line we added an English translation.

The recordings were conducted with a neutral approach, with cameras and audio recorders being placed strategically to catch both guides and public interacting but with minimum disturbance of the activities and the participants.

Permissions to record and analyse these data were sought from the institutions, guides, public and legal representatives, in case of children. Our data collection and research follows the ethical guidelines of our funding agency, university and also general ethical guidelines of the European Union and partner countries, e.g. BSA, 2017.

Analysis

The Collaborative Seeing Work of locating and identifying Objects in the Sky

Below is a set of transcripts that evidences the collaborative seeing work of identifying objects in the sky. The data in these first two excerpts were collected during planetarium sessions organized for school children. In the first example (Excerpt 1), the visitor (a child, indexed in the transcript as ‘V1’) is being instructed by the guide (indexed as ‘G’) how to locate (with a pointer) the Pole Star. As the guide gives instructions, another child (V2, who knows where the object under search is located) also helps V1 to locate the mentioned object. The seeing work is being achieved collaboratively, transforming the instructions (from the guide and V2) and the lived work of following them (by V1) into 'instructed actions' which, in this case, are the exhibited properties of finding/locating the Pole Star.

Excerpt 1

Caption: V – visitor; G – guide

```
    G   anda cá João (.) levanta-te vá, aqui na minha mão
22      come here João (.) stand up c'mon, here in my hand
23      vá tá aqui, o laser (.) onde é que está a estrela
        c'mon here it is, the laser pointer (.) where's the
24      polar?
        pole star?
25      (.)
26  V1  Ai
        ah
27      (.)
28  V2  está para ali
        it's over there
29      (.)
30  G   vá, não deixes cair isso ah  (.) ursa maior, essa
        let's go, don't drop that ah (.) ursa major, this
31      é a dubeh, dubeh e merak, portanto essa é a ursa
        is dubhe, dubhe and merak, therefore that is ursa
32      maior (.) constelação da ursa maior=
        major (.) ursa major constellation=
33  V2  =é mais para cima, é para cima=
        =it's further up, further up=
34  G   =mais pra cima (.) vá (.) tás perto (.)
        =further up (.) let's go (.) you're close (.)
35      tás perto=
        you're close=
36  V2  =mais para a esquerda (.) mais para a esquerda
        =further left         (.)   further left
```

[Place Figure 1 here]

Figure 1: Screenshots of the interaction in excerpt 1. View inside the planetarium in infrared-light. The grey area is the planetarium dome where the stars are being projected. Guide and visitor 1 (v1) are standing-up during the interaction. Visitor 2 (v2) is seated in the back and his arm raised is visible from frame 3 to frame 8. In frames 1 and 2 guide and v1 hold the laser pointer together (the guide is giving the pointer to v1) and from frame 3 to 8 the laser pointer is in v1's hands. The dotted lines represent the direction of the pointing with the laser pointer and

in frames 2 to 4 the laser dot is seen projected on the ceiling (bright dot). In the following frames the laser projection is out of frame. The arrows represent the direction of the changing in the position of pointing in frames 3 and 4 (moving to the left). In frames 6, 7 and 8 the arrows represent the movement of v2's hand to the left. The corresponding lines of the transcription associated with the frames are informed in the upper right corner of each frame.

In this extract, finding the Pole Star is a collaborative activity. First, calling V1 by his forename (João, a pseudonym), the guide gives initial instructions on how to locate the Pole Star by asking V1 to stand up, hold the laser pointer and point to the star (lines 22–24, see the first frame of Figure 1). After a short pause and a hesitation mark produced by V1 (lines 25–26), followed by another short pause at line 27, we can notice that V1 is not sure about the location of the object he is supposed to find. Finding the Pole Star first involves the work of identifying it (which works here as a proxy term for 'seeing it'). This general gloss ('seeing') is achieved by carefully following the instructions uttered by the guide and the other child (V2), who interjects (line 28) after the second pause produced by V1 (line 27).

From the accounts produced by V1, a series of further instructions take place, which comprise 'motivation' ('let's go', cf. line 30); 'instrument manipulation' ('don't drop that', line 30); 'directions to locate Ursa Major (lines 30-32) and pointer stars to the Pole Star' ('dubhe, dubhe and merak', line 31); as well as 'additional directions' ('it's further up, it's further up'; 'you're close, you're close', lines 34–35; 'further left, further left', line 36). The instructed actions originated from these additional directions can be seen in the work that the child makes with the pointer in frames 3-8 of Figure 1.

The interactional work of finding the Pole Star (and showing where it is located with a laser pointer) could not have been imagined. It could not have been described intuitively, before we witnessed how it was actually accomplished. Garfinkel (2002) insisted that instructions have indexical properties. For the analysis of instructions, which is accomplished not only by professional analysts but members themselves, *in vivo*, we need to examine the work of following instructions. The following of instructions exhibits whether instructions are clear enough, or if further instructions are necessary, as in the case here. The indexical properties of instructions are partially disambiguated when the work of following them is made accountable, i.e. when we observe what instructions mean in practice. That is why instructed actions can only be described 'as' that, not 'like' that (Garfinkel, 2002: 204).

According to Mair et al (2013: 410, quotes in the original), the looking process is 'intimately tied to the fact that "sighting" is collaboratively derived'. That means that 'collaborative seeing emerges and unfolds over time' (Mair et al., 2013: 410), which is available for close inspection in the recorded episodes we are discussing here.

Let us now turn to another example (Excerpt 2) of collaborative identification of objects:

Excerpt 2

Caption: Vs – visitors simultaneously; V1 – visitor 1; V2 – visitor 2; G – guide

45 G e está ali a terra com a lua, não é?
and the earth is there with the moon, isn't it?
46 a lua gira à volta da terra (.)
the moon revolves around the earth (.)
47 e está ali júpiter (.)
and there is jupiter (.)
48 aquela estrela que nós estamos ali a ver é
that star we can see over there is
49 tão grande quanto a órbita de júpiter=
as big as the orbit of jupiter=
50 Vs =((suspiro))=
=((sigh))=
51 G =tão a ver?=

```
         =can you guys see it?=
 52  Vs  =(suspiro))
         =((sigh))
 53      (.)
 54  G   sim ou não?=
         yes or no?=
 55  Vs  =a:h, sim sim sim sim sim sim=
         =o:h, yes yes yes yes yes yes=
 56  V1  =é maior do que o sol
         =it’s bigger than the sun
 57      (.)
 58  G   muito maior que o sol muito maior que o sol=
         much bigger than the sun much bigger than the sun
 59  V2  =então é muito muito maior que a terra
         =so it’s much much bigger than the earth
```

Identifying objects in the sky is not only a matter of pointing and finding, but also of knowing about their properties, e.g. how large they are, what their shapes are like, colour, brightness, how fast they move and so on. In the case presented above, the guide is projecting a model of the orbiting planets around the Sun in the planetarium ceiling, while he also shows the other stars. He is providing a variety of details so the activity will not be reduced only to the action of seeing a small dot in the sky, but to a more complete picture of the object under observation.

The object in question is a giant star (Betelgeuse), many times larger than our sun (around 2,193 times) and it is difficult for children to ‘see’ that particular property based on their knowledge of the Universe. Even more difficult is explaining this property through a mathematical calculation, or a ‘proxy’ (since we cannot measure the star size directly) because any calculation would not satisfy the visual representation by the recipients (school children) participating in that event in the planetarium. The guide needs another proxy, a simpler one; and the way the guide elaborates this proxy also depicts the way the guide is orienting to the recipients of his talk. This is a form of what Sacks called ‘recipient design’ (Sacks, 1995, Vol. II: 438).

The guide gives the children an approximate measure of the star's size, comparing it to the orbit of Jupiter. This starts to be done previous to the part transcribed in Excerpt 2, when the guide projects an image of the star, captured by the VLT (Very Large Telescope) and draws with the laser pointer the approximate location of Jupiter's orbit in relation to the star (see Figure 2).

[Place Figure 2 here]

Figure 2: The image of Betelgeuse projected on the ceiling of the planetarium and the circular movement of the laser pointer (red lines) representing Jupiter's orbit.

However, in order to facilitate this collaborative seeing of the size of the star, the guide also projects a 2D model of the Solar System on the ceiling, as shown in Figure 3. He has to be sure that the visitors first can locate the Earth and the Moon in the projected model of the Solar System, and then that children know that the Moon has an orbit around Earth (lines 45-46). Finally, the guide can refer to the orbit of Jupiter around the Sun and compare the star they were looking at to the size of Jupiter's orbit (lines 47-49).

[Place Figure 3 here]

Figure 3: 2D model of the Solar System projected on the planetarium ceiling. The dots represent the planets moving around the Sun and their circular movements represent their orbits. In frame 1 the guide points to Earth with the laser pointer (red dot) and makes circular movements around the planet to represent the orbit of the Moon. In frame 2 the guide points to Jupiter using the laser. In frame 3 the guide makes circular movements with the pointer to represent the orbit of Jupiter, which corresponds to the size of Betelgeuse. The corresponding lines of the transcription associated with the frames are informed in the upper right corner of each frame.

This is not an easy job. However, we can notice that the guide was successful. Given the silence and sighs produced by the children at lines 52-53 of Excerpt 2 after the guide asked the question ‘Can you guys see it’ (line 51), we can say that the collaborative seeing is now achieved and the children could follow (for the practical purposes of this event) what the guide is trying to describe to them. The next moves in the sequence, i.e. the ‘oh’ moment and the many ‘yeses’ produce at line 55 followed by the formulation ‘it’s bigger than the sun’ (line 56) prove that the children can now grasp the size of the object. It is also interesting to notice one child (V2) formulating another comparison at line 59 between the sizes of the Earth and the star under observation. This move indicates that V2 can now ‘see’ the size of the star even though what is in his field of view is just a dot on the ceiling of the dome.

This previous excerpt is also an example of how the guide helps visitors make sense of what they see. However, this help would not be possible without children’s active participation in answering the guide’s questions. What happened then was a collaborative accomplishment, a topic which will be discussed in more detail in the next section.

Making Sense of What is Seen as a Collaborative Accomplishment

Consider the following excerpt, retrieved from a sky observation session carried out in an observatory dome, where a guide and a group of visitors were spotting an asteroid through a telescope. We can see how the guide formulates the task with a direct instruction, i.e. he specifies what the visitor will see at the outset.

The utterances produced by the guide and visitor in Excerpt 3 below will provide us with an example of how visual accounts are not unilaterally produced. In the case depicted here, those accounts came off through the skillful instructions provided by the guide (e.g. what to see and how to see it) and the attentive tokens of confirmation and further descriptions given by the visitor. In short, the excerpt bellow will show visual accounts being collaboratively achieved and accounted for in a sequential production of the task.

Excerpt 3

Caption: V – visitor; G – guide

```
 6   G   a senhora vai ver  (.) uma
         mam, you will  see (.)  a
 7       coisa minúscula=
         very small thing=
 8   V   =sim, já tô a ver=
         =yes, I can see it=
 9   G   =que parece que é=
         =that looks like ah=
 10  V   =eu sei que estão lá juntos=
         =I know that they are there together=
 11  G   =mas primeiro tem que se fazer uma genuflexão (.)
         =but first you'll have to kneel down (.)
 12      pra pra (.) senão não ((   )) este ponto que está
          to to  (.) otherwise ((   )) this point that you
 13      a ver, sim (.) contrariamente ao que possa a:h
          see , yes (.) different from what you might a:h
 14       pensar  (.) não é uma estrela
         think of (.) is not a star
 15      (.)
 16  V   é um asteróide=
         it's an asteroid=
 17  G   =é um asteróide,  sim ((  ))
         =it's an asteroid, yes (   ))
 18      (.)
 19  V   mas muito longe?
         but very far?
 20      (.)
 21  G   mas (.) muito longe
         but (.) very far
 22      (.)
 23  V   pois
         I see
```

Excerpt 3 is a moment during the observation where the guide addresses a visitor who has just joined the group and gives her instructions on how to look through the eyepiece of the telescope. With the help of the visitor delivering confirmation tokens such as 'yes, I can see it' and 'I know that they are there together', the guide carefully spells out the 'circumstantial particulars' (Sormani, 2010) of the task in a sequentially organized manner. For each instruction (lines 6–7, 9, 11–14), the guide gets responses from the visitor (lines 8, 10 and 16), which allow him to produce subsequent utterances.

The seeing work here is being collaboratively produced. A crucial moment of this collaborative work is when the visitor finally formulates what she is looking at (line 16 'it's an asteroid'). The guide first describes the size and shape of the object ('a very small thing', 'that looks like ah', lines 7, 9) and then specifies the what the point is, which is not a star but an asteroid, providing instructions on how to do this ('different from what you might think of', 'is not a star', lines 13, 14). Here we notice that through the instructions given by the guide, the visitor can finally characterize the object as an asteroid (line 16, 'it's an asteroid'). This characterization is confirmed by the guide at line 17 ('it's an asteroid, yes'). The 'it' uttered at lines 16 and 17 works as a tying element (Sacks 1995, Vol. I, 150), which refers back to the specification made by the guide at the very first lines of this excerpt (lines 6-7, 'a very small thing' 9, 'that looks like ah'; 12-14, 'this point that you see', 'different from what you might a:h think of (.) is not a star'). Similarly interesting to the collaboration work between guide and visitor, here is the complement provided by the visitor at line 19 ('but very far?'), which extends the description of what is being observed and 'invites' confirmation from the guide at the subsequent utterance (line 21) due to the high tone produced at the end of the visitor's utterance at line 19. The conjunction 'but' produced by the visitor in the beginning of line 19 is another tying element, which shows how the utterances produced by the guide and visitor here are aligned and that they belong to a joint effort to characterize the object under observation.

The following excerpt is from a planetarium session organized for primary school children.

Excerpt 4

Caption: Vs – visitors simultaneously; V1 – visitor 1; V2 – visitor 2; G – guide

```
18  G   posso desenhar outra coisa?
        may I draw something else?
19      (.)
20  V1  sim
        yes
21      (.)
22  G   uma duas três quatro cinco seis sete.
        one two three four   five  six  seven.
        ((moving a laser pointer across the ceiling and
        drawing the asterism of ursa major))
23  Vs  ursa maio:r
        ursa ma:jor
24      (.)
25  G   posso desenhar outra coisa?
        may I draw something else?
26      (.)
27  V2  °sim°=
        °yes°=
28  Vs  =ursa meno:r
        =ursa mi:nor
29      (.)
30  G   uma, duas, três, quatro, cinco, seis, sete. O que que
        one, two, three, four,   five,  six, seven. What have
        ((using the laser pointer and drawing the asterism of
        ursa minor))
31      é que eu desenhei?=
        I drawn?
32  Vs  =ursa meno:r
        =ursa mi:nor
33      (.)
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```
34  G   a ursa?=
        ursa?=
35  Vs  =meno:r=
        =mi:nor=
36  G   pronto
        indeed
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This excerpt depicts a moment when the guide was using a laser pointer to virtually draw the shape of asterisms, i.e. group of stars that form patterns or parts of constellations, onto the image projected on the ceiling of the dome. The guide was doing that by pointing at specific spots on the ceiling (see Figure 4).

[Place Figure 4 here]

Figure 4: Infrared view of the portable planetarium where the interaction depicted in Excerpt 4 happens. Guide and public are seated on the floor. In the image the guide is positioned behind the projector (located at the center of the planetarium) and his arm and hand are visible pointing with the laser pointer in the direction represented by the dotted line. He is pointing to the stars of the big dipper projected on the curve ceiling of the planetarium dome. He is enumerating the 7 stars one by one, as at line 22 of Excerpt 4. A representation of the drawn made with the laser pointer on the ceiling is represented in Figure 5.

Each spot pointed by the guide represented a star and the set of spots linked together represented the shape of the asterism of a constellation. However, the connection among the spots, which actually formed the shape of the asterism, was not being actually projected as the guide was using a laser pointer that left no trace of the image produced by its light. This was a task left to the visitors to do, who had to use their knowledge about the shape of each constellation to connect the spots imaginatively and provide the right answer. According to the answers provided above, the visitors seemed to perform this task very well.

The perceptual orientation to this task which explicates the phenomenon depicted here is the interdependence and interdetermination of many resources, i.e. gestalt-contexture and gestalt-coherence (Gurwitsch, 1964; Wieder, 1974; Garfinkel, 2002). These intertwined features could be described in this way. First the interconnection of the spots which linked together resembled a single, meaningful whole, i.e. the asterism, which was the recognizable part of another whole, i.e. the constellation. Second, the guide's talk, which instructed the visitors to follow a logical numerical sequence of connecting points at the time that a new spot generated by the pointer appeared on the ceiling (see lines 22 and 30). Third, the previous knowledge that visitors had about the shape of constellations. This helped them make sense of the connecting points and find out to which constellation that shape (in fact, the asterism) belonged.

The asterisms in the case here are 'the Big Dipper' (a part of the Ursa Major constellation) and 'the Little Dipper' (a part of the Ursa Minor constellation). Both are formed by seven points and those points represent stars. However, neither the Big Dipper nor the Little Dipper were visible to the visitors. The guide then uses the pointer to locate the position of the stars and also his talk to count the number of stars he is trying to refer to. Here we can note that the shape of the objects (the asterisms) is dependent on the way that the visitors are instructed to see them. In other words, there is no separation between the movement that the guide is performing with the pointer, his talk counting the sequence of stars and the children's previous knowledge about the dippers and the constellations. That means that pointer manipulation would probably not be enough for the children to recognize what the guide was trying to refer to. That happens because each element of a whole opens too many possibilities that a participant ‘can find no grounds for choosing one possibility over the others’ (Wieder, 1974: 199). Any element here (pointer manipulation, guide’s talk, children’s previous knowledge) analysed in separation would provide the participants with little clue of what was being drawn by the guide. They could only ‘see’ what the guide was trying to draw through the mutually elaborating aspect of what Gurwitsch (1964) called the ‘inner horizon’ of those elements. Wieder (1974: 199, emphasis in the original) gives us a good example of this:

> The appearance of a house from the front, for example, while not showing the backside, none the less makes necessary reference to *a* backside for the appearance to be a perception of a house. The backside of the house is thus an aspect of the inner horizon of the perceptual appearance of the house-viewed-from-the-front and is co-constitutive and co-determinative of that perceptual appearance.

Then, the Dipper can be found when the guide instructs (by enumerating the stars) the visitors on how to look at what he is doing with the pointer, which also depends on the previous knowledge the visitors had about the Dipper, *i.e.* of how many stars it is formed. The Dipper, once recognized, becomes an aspect of the perceptual appearance of the constellation. All elements are then part of the inner horizon of the perceptual appearance of the whole and any separation would make the visitors lose the object.

A proof for this argument can be viewed below (Figure 5), where we intentionally try to separate the phenomenal properties of the Dipper (represented in Figure 6) as it was instructionally referred to by the guide:

[Place Figure 5 here]

Figure 5. The guide drawing the Big Dipper with a pointer on the ceiling of the planetarium. The stars represented in the image by the blue dots are projected on the ceiling. The dotted lines connecting the stars are not being projected as they were added by the authors to represent the path the guide made with the laser while enumerating the stars and drawing the asterism of the Big Dipper. The red arrow of the pointer is visible near point number seven.

The numbers indicate the sequence in which the guide pointed to the ceiling. The gap between each pointed spot (represented by dashed lines) is less than 0.2 seconds. If we only take the figure above into consideration and put aside the guide's talk and the previous knowledge that visitors had about the Dipper, then we would have no rights to claim that there was coherence between the drawing and the visitor's responses at line 23.

[Place Figure 6 here]

Figure 6: An Illustration based on the real shape of The Big Dipper. Illustration made by Bob King available at Astronomy Trek: https://www.astronomytrek.com/step-6-interesting-facts-about-ursa-major-1/ Accessed 6 September 2021.

The visitors' achievement then cannot be restricted to the visible spots on the ceiling, e.g. as a stick figure as Gurwitsch (1964) referred to in his theory of Gestalts, but as accomplishments in, of, and as concerted practical actions (Garfinkel, 2002). The object formed on the surface of the ceiling cannot be the object that the visitors are committed to. It has more properties than that. It has to do with the historicity of the instructions that the visitors received at school and the careful indications that the guide provided to them (under the form of an enumerated pattern, see lines 22 and 30) that helped the visitors see what the guide was trying to draw. This historicity is even clearer at lines 25-28, when the guide announces he will be drawing something else. Before he does that, however, visitors were able to guess the answer, i.e. 'Ursa Minor', line 28. That happens because the constellations Ursa Major and Ursa Minor are usually mentioned by teachers and guides one after the other, which forms a sequential pattern that visitors might know in advance. This historicity is also present in the guide's actions, who counts on it to communicate the contents he has to cover during the planetarium visit. Nonetheless, it is important to mention that this historicity is accomplished locally, in a situationally conditioned way (Garfinkel et al., 1981), since the guide also produces accounts that informs the type of public he is working with at that moment. In other words, his talk displays sensitivity to the categorial incumbency of other participants in a 'turn-informed' way (Watson, 2015). His actions show how he is designing his recipients and adapting/shaping his talk and other actions according to that orientation.

Conclusion

The seeing work described and discussed in our paper became available for close inspection through the linguistic exchanges carried out by members themselves. We explicated how the seeing work is collaboratively achieved in conversation, which is a place where members categorize each other and display their *in situ* visual orientations. Visual perception cannot then be treated as being constituted and made meaningful by individual minds (Evans and Fitzgerald, 2017; Heath et al., 2002). Visual perception is a socially accomplished enterprise made accountable in and as of the linguistic practices produced by members engaged in the work of seeing.

This means that visual elements are not just an add-on feature of the interaction, but a fundamental aspect of communication; and their meaning is inextricably intertwined with talk as a unified contexture (Gurwitsch, 2010; Greiffenhagen and Watson, 2009; Garfinkel, 2002). Moreover, while the accounts of seeing work are usually performed by one co-participant per time, participants do not necessarily ‘own’ the outcome of that act, since it is the result of a ‘conjoint production’ carried out by members.

Another point important to add, however, is that it does not necessarily mean that members always have an equal status in the interactions we are exploring. There might be (as evidenced in our data) asymmetries regarding professional and technical competence (Greiffenhagen and Watson, 2009), e.g. knowledge of the object under observation and access to the eyepiece of the telescope. As observable in our data, guides usually have more knowledge on astronomical phenomena than visitors and this knowledge imbalance becomes visible while talking about what they are seeing. However, those elements were explored in our discussion in their own right, i.e. ‘as materials that are inextricable features of cultural practices’ (Carlin, 2003: 9), according to the practical actions displayed by members.

Close inspection into this visual orientation suggest that what is seen is not just the image itself that reaches our retinas, but contain also the visual representations collaboratively and accountably produced within the seeing work carried out by guides and visitors. The seeing work is achieved in talk by the practical, visible and competent actions of the members, who engage in activities to produce the seeing or, as Garfinkel et al. (1981: 132) said, ‘to extract an animal from the foliage’.

Given this, there is no substitute, no indirect description in terms of ‘contents to follow’, as carefully spelled, e.g. in science textbooks, that can provide evidence of how a planetarium session or an observation with telescopes can be successfully accomplished. This is only described by a close look into how members actually produce seeing. In this paper, we discussed how seeing is an activity made accountable by members. The ‘circumstantial particulars’ found in our data that brought the interactions under observation to a successful accomplishment, e.g. through sequential organization of turns, instructions and instructed actions, were made visible by repeated and close examination of how members did the complicated work of making sense of what they were seeing as another-first-time activity. This does not mean that there is no typical sociological or linguistic explanation of patterns of action in the work of seeing astronomical phenomena; see, for example, that the circumstantial particulars ‘seeing by proxy’ and ‘instructed actions’ that were also described and explored in other studies using data from different settings (Authors, 2020; Authors, 2021a; Garfinkel, 2002). However, they are circumstantial particulars because they are invoked by the participants in their interactions, which are local and unique for that specific context produced during the course of members’ actions.

In common with other daily practices, seeing is a staple feature of our routine. Therefore, even when people are acting in specific spaces, such as in planetariums or at star parties, they still use and rely upon their common sense to see and identify objects (see the children guessing the answer before they actually see what the guide draws, at line 28, excerpt 4). In this paper, we addressed how (visitors and guides) do this complicated work collaboratively and which particulars are involved in this task.

These results are of special value to guides and trainers, since grasping how visitors produce visually-informed accounts is crucial to successfully organize outreach events. Moreover, and as we stated elsewhere (Authors, 2021b), guides who participate in our studies are usually very experienced. Therefore, knowing their working practices in detail, e.g. how they communicate visual elements to the public and how the public collaboratively respond to their effort, and exploring them as topics provides very important materials for guiding training programs.

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