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RESEARCH ARTICLE

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Abstract

During agroecological transition, farmers test and adjust new cropping practices that can enhance the ecosystem services of their agrosystems. Supporting farmers to change their practices requires a description and understanding of the step-by-step design of innovations, and the learning processes that unfold with the farmers' actions. Our research focuses on the re-introduction of horse-drawn tillage in viticulture, during on-farm experimentation involving the collaboration of a service provider. Our objective is to show how our research approach, based on the use of videos, allows us to access, characterize and share the knowledge embodied and mobilized in situ by the service providers, considered here as farmers. To do so, we mobilized the methods of the course-of-action research program. First, we filmed the hilling operations performed by two service providers on thirteen plots. We then conducted their self-confrontation interviews to highlight their implicit and invisible activity. Next, we conducted an allo-confrontation interview with a third service provider to validate/invalidate and complete the knowledge mobilized during the hilling activity. Finally, through a comparative analysis, we developed a first provisional qualitative modeling of the hilling activity. We thus show that the equine traction service providers used not only visual cues but also sound, tactile and relational cues with the horse, to adjust their practices; and we illustrate the advantages of using videos to decompose the individual activity of service providers, then to share and compare this activity with those of peers and, finally, to recompose the hilling activity in a qualitative model by identifying key dimensions structuring the activity.

The use of digital technology makes it possible to construct data on farmers' learning processes as they change their practice to support agroecological innovations. The material produced and the insights gained can contribute to the building of digital resource banks that are valuable tools for training.

Keywords: equine traction, hilling operation, viticulture, agroecological practices, experimentation, digital resources, course-of-action, self-confrontation interview, allo-confrontation interview.

1 Introduction

In France, viticulture accounts for only 3% of the country's agricultural surface area yet consumes large quantities of phytosanitary products: 20% of all pesticides used. (Agreste 2019). Most phytosanitary treatments concern fungi management (Agreste 2019), and herbicides are applied on 80% of vineyards (Agreste 2019). Although representing only 5% of the total treatment frequency indicator (Agreste 2019), herbicides have deleterious impacts on the environment. Those impacts include pollution of surface and groundwater, resulting in a failure to meet drinking water quality standards (Ministère de la Transition Ecologique 2020), and lower biological quality of the soil (e.g., decrease of the population of beneficial nematodes and mycorrhizal fungi; Karimi et al. 2020). As soil quality impacts vines' growth and vigor, and the quality of the grapes, it is essential for winegrowers to implement practices that sustain life in the soil. Thus, practices such as mechanical weed control and permanent or temporary soil cover are developing as alternatives to chemical weed control in many wine growing areas (Mailly et al., 2017). Soils in certified organic or biodynamic vineyards where these practices are used have a higher microbial biomass, except for earthworms whose population is affected by mechanical weeding (Karimi et al. 2020).

The challenge of reducing the use of chemical inputs and enhancing the ecosystem services of their agrosystems pushes farmers to experiment with new agroecological practices (Catalogna et al. 2022). Two main principles of agroecology aim (1) to reduce the use of chemical inputs by relying more on the ecosystem services provided by the preservation of biodiversity, and (2) to base interventions on observations made on the agrosystem in an adaptive approach and not to apply a "recipe" in advance (Altieri 2002). In France, horse-powered tillage is one of the mechanical weeding practices that winegrowers experiment with. This practice can be considered agroecological for four main reasons. First, working with a horse instead of a tractor reduces the use of fossil fuel (Rydberg and Jansén 2002). Second, horse-powered tillage limits soil compaction (Garcia-Tomillo et al. 2017) and consequently avoids erosion and the disappearance of living organisms in the soil. Third, thanks to interaction with the horse, this tillage method encourages winegrowers to pay attention to their soil and to adapt to the dynamic conditions of the agrosystem. They have to adjust their methods according to the horse's capabilities (Mulier and Müller 2019), the characteristics of each plot (age of the vines, type of soil, presence of slopes, etc.), weather conditions, and their own objectives (Bénézet et al. 2021). Fourth, this practice engages a physical and sensorial dimension, particularly during interaction with the soil and the horse (Bénézet et al. 2021), which we assume facilitates farmers' learning.

Recent studies on changes of cropping practices during the transition to agroecology (Chantre et al. 2014; Toffolini et al. 2016; Catalogna 2018) have focused on how farmers learn new ways of cropping. According to Toffolini et al. (2016), identifying the knowledge applied by farmers when redesigning their farming systems step-by-step would make it possible to improve the support for the agroecological transition provided by research and agricultural advisors. The trial-and-error experiments carried out by farmers generate exploratory learning (Chantre et al. 2014) that favors the evolution of their practices. Through experimentation, farmers progressively and autonomously design and adapt (Prost et al. 2020) their agro-ecosystems. Could the use of draft horses in vineyards contribute to these experiments and learning? Horse-powered work requires "understanding stewardship embodied in working a team of horses" (Kendell 2003). The majority of winegrowers using horse-powered tillage have chosen to work with a service provider (estimated at 63%, IFCE and IFV 2021) so that they do not have to manage horses or to invest in specific equipment. They are thus accompanied in the change process by a service provider who, using previous experience with other agrosystems, acts as an advisor. The winegrower and service provider twosome seeks to adjust the tillage practice to a specific agrosystem by testing new modalities and observing their effects. This approach is close to experimentation as defined by Catalogna (2018), that is, a process of testing practices that involves making hypotheses on both their implementation and the agroecological processes that these practices aim to induce. Farmers often rely on visual cues (Toffolini et al. 2016) to observe their agrosystems and interpret their evolution, notably with regard to new practices. These cues help them to adjust their interventions progressively and adapt their strategy. Catalogna (2018) mentions the advantages of monitoring experimental situations in progress to facilitate the identification of these cues and the knowledge mobilized in the action. Farmers may have difficulties remembering these cues when they are no longer in the field, especially since "they very rarely keep written records of experiments" (Catalogna 2018).

This raises the difficulty of keeping traces and highlighting the empirical knowledge built by farmers during the redesign of their agrosystems, especially since these experiments are often not accompanied by researchers or agricultural advisors (IFCE and IFV 2021). We postulate that highlighting the knowledge elaborated during the work with draft horses and sharing these experiences could be a way to promote agroecological innovations in French vineyards. Agricultural research however lacks theoretical and methodological tools to identify the situated knowledge of farmers in the field. In the continuity of the research on situated cognition (Suchman 1987), we postulate that analyzing work while it is underway informs the study of the dynamic interactions between humans and their technical, social and cultural environment. Among the main current trends in work analysis, the course-of-action research program (Leblanc et al. 2001; Theureau 2003) approaches work holistically by jointly studying six aspects: (1) the experience that serve to describe what the actors do, think or feel at the moment; (2) the focus on what they take into account to act; (3) the knowledge allowing them to adapt their activity dynamically following the focuses encountered; (4) the anticipation of how they expect the situation to evolve; (5) the intentions of what they try to do; and (6) the learning resulting from a possible modification of knowledge linked to the situation encountered (Poizat and San Martin 2020). The course-of-action research program greatly differs from other approaches where behaviors are observed from an external point of view, which is only the tip of the iceberg: actions and communications. If no one asks them to comment on their work in progress, a whole part of their activities remains invisible, especially sensations/emotions, focuses, knowledge, anticipations, intentions and learning (Poizat and San Martin 2020). One difficulty is that, in certain cases, asking actors to comment on their work while they are performing it interferes with the "natural" course of that activity. They may find it difficult to explain what they are doing while they mobilize their bodies to do it. But conversely, the time lag between the work situation and the interview requires farmers to record traces of the activity, to help them to remember their experience. Two efficient tools based on video recordings have been developed to record traces of an activity and help actors to comment on their experience: self- and allo-confrontation interviews. The self-confrontation interview (Poizat and San Martin 2020) aims at putting actors back into a dynamic situation by showing them their behaviors, using video recordings of field situations and specifically-worded questions. The second type of interview, allo-confrontation (Mollo and Falzon 2004), is conducted to understand the convergences and divergences between the activities of peers in comparable situations. During the allo-confrontation interview, an actor is first shown video clips of filmed situations of peers at work, followed by comments from these same peers on what is invisible (i.e. their concerns, intentions, etc.). Then, while viewing the videoclip or afterwards, the interviewee in allo-confrontation engages in reflection on their own knowledge that they mobilize in this type of situation, presented here by another person (Mollo and Falzon 2004). This two-phase interview process allows for a gradual increase in genericity, and thus for the identification of typical knowledge related to a practice that is found among the majority of actors, as well as more specific knowledge related to the conditions of implementation of the practice. Typical knowledge is that which is recurrently mobilized by the actors during their work situation (Flandin et al. 2017).

Our study focuses on horse-powered soil tillage in vineyards. With the course-of-action research program, we aim to describe, understand and possibly explain how the interaction with the horse can favor the mobilization of physical and sensorial cues and of knowledge useful to the implementation of agroecological practices in vineyards. In this theoretical framework, the activity is the result of an asymmetrical coupling between the actor and his environment, which includes the horse but also the soil, the plow, the weather, etc. In our case, we consider what the actor considers in this environment to act. In this study, we focused on the activity of service providers (plowmen) rather than winegrowers (Figure 1), because they currently are more experienced and have a deeper understanding of horses. Moreover, we consider service providers as farmers because they replace the winegrowers on one of their missions, which is the soil maintenance of their plots. However, as some winegrowers also lead horses themselves, we postulate that our model and results would also be accurate for them. We hypothesize that understanding the interaction between the horse and the service provider at work on plots will help us to understand the interaction between the winegrower and the horse, whether or not it involves a service provider. In this paper, we focus on the analysis of individual activity during the soil intervention with the horse.

Figure 1: Horse-powered tillage driven by a service provider on a vineyard plot © Bénézet.

In Section 2, we describe the study (location, actors involved) and present the methodological framework of the course-of-action used to make service providers elicit their knowledge, based on video recordings, self- and allo-confrontation interviews, and the data analysis method. In Section 3, we present and discuss the results in 4 points. First (1), we show how the step of selecting the best points of view of the activity with the service provider for video recording begins to inform the latter’s visual cues to adjust their activity in a dynamic way. Next (2), we present the advantages of self- and allo-confrontation interviews based on video recordings to access the knowledge and bodily cues that service providers mobilize during horse-powered tillage. Then (3), we describe the knowledge and cues mobilized in action, based on the analysis of the activity of three service providers. Finally (4), we show how this analysis leads to a provisional modeling of the activity that serves to develop a platform of video-trainings re-using digital data resulting from the research as support for the change of practices.

2 Materials and methods

Among the different tillage activities performed with horses, we selected hilling, which consists in forming a homogeneous mound of soil along the vines. This choice of the hilling activity is linked to the fact that soil tillage by horse traction is mostly done under the vine row, i.e. as close as possible to the vine plant. Hilling has three main objectives for the winegrower: protect the vines in winter (Jolivet and Dubois 2000), bury the weeds, and facilitate winter water flow. According to service providers, hilling is the key operation that frequently starts the soil tillage season and on which the other soil tillage operations such as plowing the ridges depend. When done well, hilling facilitates ridge plowing, whereas poorly done hilling can complicate the ridge plowing progress and thus demand extra effort and generate additional fatigue for both the horse and the service provider. We had to adjust the methodological framework of the course-of-action program to the observation of horse-powered tillage. This consisted in finding the best angles for the cameras, to ensure that the service providers would be able to remember their activity during the self- and allo-confrontation interviews. We then implemented the research device on several vineyards to understand how service providers, in close interaction with their horses, learn about the soil conditions and nature on the plots they work; in other words, what cues and knowledge they mobilize during the tilling.

Among the different approaches of work analysis, the choice of the course-of-action research program (Theureau 2003; Poizat and San Martin 2020) allowed us, thanks to its theoretical and methodological framework, to analyze activity in its embodied dimension through the perceptions and sensations experienced by the service provider. Our study was structured in seven steps (Figure 2). The first step was to build a field of study and collaboration with the service providers, to involve them fully in our research project. We therefore chose to work with three experienced service providers with whom we had already collaborated. The trust built between the researcher and the service providers prior to the study facilitated the swift development of our methodology. The second step was to film service providers A and B in hilling activities on different plots from several angles so that their activity could easily be seen, reviewed and shown. The third step was to conduct self-confrontation interviews with service providers A and B, based on records of their hilling activity on different plots to access the implicit, non-visible dimensions. The fourth step was to adapt the camera angles on the activity corresponding to the service provider's needs, to facilitate their expression about the activity. The fifth step consisted in analyzing the individual activity of the two service providers A and B, to identify convergences or specificities, particularly in terms of knowledge mobilized during the action. Based on this analysis, we designed thematic video clips combining hilling situations and comments from the service providers A and B on situations related to the theme of the video clip. The sixth step was to conduct an allo-confrontation interview with service provider C based on these thematic video clips to validate, invalidate or complete the register of knowledge mobilized during the hilling activity. Finally, the seventh step was to carry out a comparative analysis of all data from self- and allo-confrontation interviews to propose a first provisional model of the hilling activity resulting from the analysis of the activity of these three service providers (Figure 2).

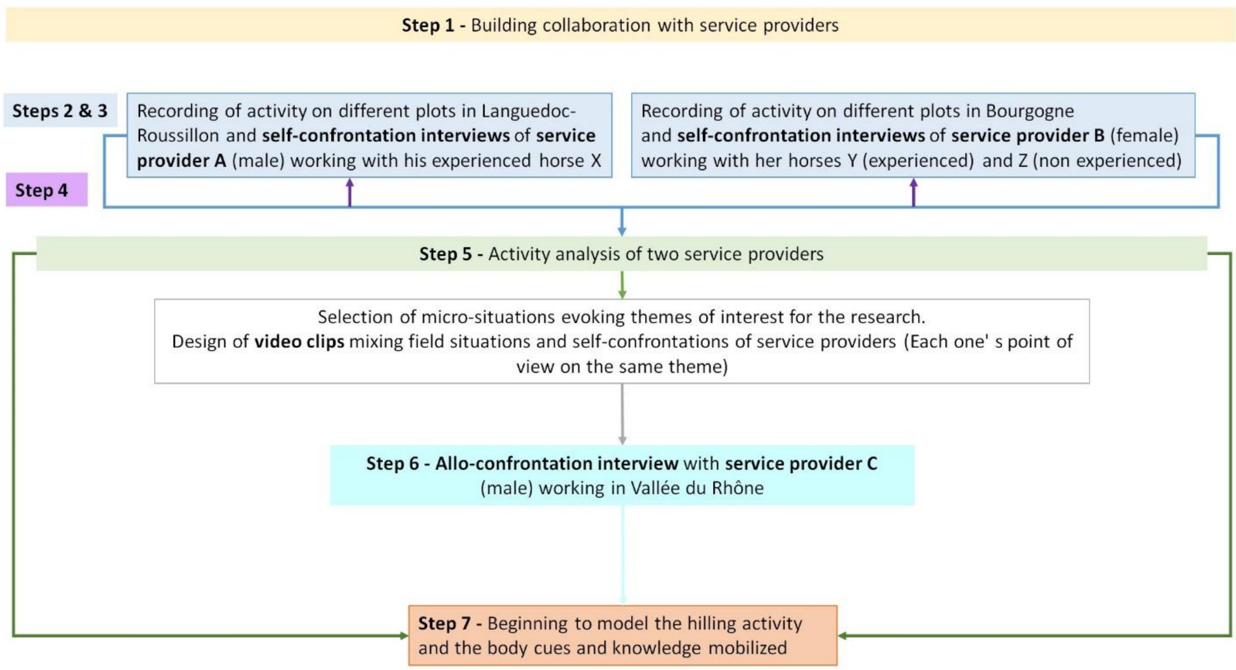

Figure 2: Method used to record and analyze data based on seven steps, leading to the model of hilling activity by horse-drawn service providers.

2.1 Data construction

In step 1, we selected three experienced service providers, two men (A and C) and one woman (B), all three with between 8 and 19 years of experience, working with several vineyards in three different wine-growing regions (Bourgogne, Languedoc-Roussillon, Vallée du Rhône). We observed hilling activity on thirteen plots during five working days in November 2020: three plots worked with one experienced horse for service provider A, and ten plots worked with two horses (one experienced and one training course) for service provider B. The plots were selected with the two service providers for their contrasting soil and crop characteristics (more or less sticky soil, presence or absence of slopes, more or less narrow rows). The aim was to observe and record the hilling activity under different conditions, which were supposed to lead to specific adjustments of the hilling activity from the service providers. Thus, we hypothesized that these contrasting conditions of intervention would allow access to the typical and structuring dimensions of the activity.

2.1.1 Collecting information on the conditions of intervention

In the theoretical approach of situated action, the environment transforms the action, and the other way around (Suchman 1987; Theureau 2003). It is therefore essential to describe the context of the situation to be analyzed. The information collected, thanks to ethnographic notes throughout our participant observation, concerned mainly the characteristics of the worked plot (condition and nature of the soil, slopes) and the service providers' adjustments to their equipment (settings and characteristics of the plow used), specifically related to the worked plot and the partner horse for the intervention (age, experience, working behavior). We posited that these elements could either influence the service provider's hilling activity and their interaction with the horse, or reflect an adjustment of their activity to the specific situation in which they were engaged. They are moreover an aid on which the researcher can rely to accompany actors in accessing their experience during self-confrontation interviews.

2.1.2 Video recording of hilling situations

Step 2 consists in video recording. The video recording of the situation is a tool to co-investigate and understand the point of view of an actor in situ (Leblanc and Azema 2022). In our case, video recording the service provider was intended to obtain information on what happened during tillage along a row without interrupting the activity. This information concerns both visual and spatio-temporal aspects present in the images that scroll through the video (dynamic interactions between the soil, the plow, the service provider, and the horse). For example, when using video, we can finely decompose the spatio-temporal flow of the activity and in particular the behaviors of the service provider and the horse when the plow hits a stone in the ground and is deviated from its trajectory. The video moment can be replayed over and over again, or slowed down, to facilitate this observation. The video also integrates sound information (communication between the service provider and their horse, sound of the iron plow's impact on the ground, the horse's snorts, etc.).

Game (2001) says that "[horse] riding involves an 'absorption' of movement with 'loins' and 'seat': absorbing horse, taking horse into our body". We hypothesized that horse-powered tillage, also involving human-horse interaction, presents a similar strong embodied dimension, with a multitude of senses being simultaneously mobilized by the service provider to act. It can sometimes be difficult to put this bodily experience into words in the continuous flow of action, and the use of video recordings allows the service provider temporarily to "pause" the flow of the activity to comment on or mime a particular aspect.

To record such information, we used two video devices, positioned initially at two angles to benefit from different views of the activity (view 1 in Figure 3). On one side, a Go-Pro was harnessed to the service provider's chest and focused on the plow and the horse's hindquarters (view 2 in Figure 3). On the other, a hand-held camera was carried by the researcher and focused on the service provider to record their movements (view 3 in Figure 3).

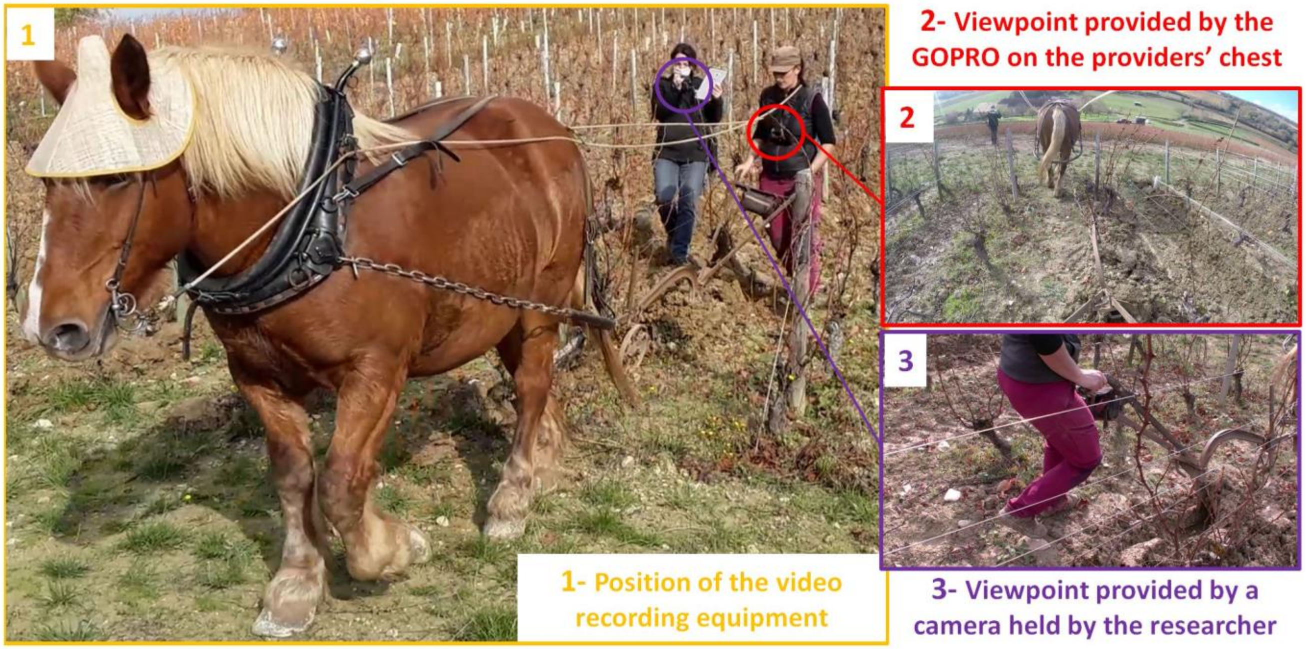

Figure 3: Illustration of the three tested positioning and viewpoints of video recording devices.

2.1.3 Self-confrontation interview with service providers A and B

In step 3, to understand their situated point of view, we conducted, as close as possible to the activity recorded (preferably at the end of the hilling day), an individual self-confrontation interview with service providers A and B. The researcher chose to conduct the self-confrontations individually because he considered that this would facilitate the free expression of each of the actors on their own activity without fear of judgment by a peer. These interviews were based on video recordings of their behaviors and those of the horses during the daily activity. They were filmed so that they could be analyzed later by the researcher. The choice of the sequences viewed on each of the plots was made jointly by the service providers and the researcher. In order to understand each service provider's activity and the cues they used to act, it was necessary to help them immerse themselves precisely and dynamically in the situation they had experienced. Thus, the service providers were invited to choose the best angle to enable them to dynamically re-situate themselves in the situation previously experienced and recorded (step 4), and to suggest possible modifications to be made to these points of view during the following days of observation of the activity. After selecting the camera's angles of view, we accompanied them as they described their experiences while the viewing the videos. Specific questions allowed us to access the different areas of the activity proposed by the course-of-action research program, which are experience (actions/communications/sensations/emotions); focus; knowledge; anticipations; intentions and learning.

To understand and correctly identify the service provider's actions and communication during the sequence, we asked the following questions: What are you doing? Do you say anything in particular to yourself? Do you feel any emotions? Is there anything particular about your sensations at that moment? Or about your relationship with the horse, with the land? We furthermore wanted to identify their focus ("What are you paying attention to?"), their preoccupations and intentions ("What are you trying to do?"), and the knowledge they mobilized ("What made you do that at that moment"?).

2.1.4 Allo-confrontation interview with service provider C

The analysis of the activities of the service providers A and B (step 5) allowed us to identify converging or specific elements concerning the organization of the hilling activity in progress. Based on these elements, we produced 5 thematic video clips lasting between 1 minute 30 and 4 minutes 15 extracted from the previous video recordings of hilling situations and of self-confrontation interviews. The 5 themes, generated inductively through the analysis of individual activities and their comparison, were: (1) service provider-winegrower relationship; (2) mobilization of the service provider's body; (3) equipment settings; relationship between the service provider (4) with the plot or (5) with the horse (education, training, divergent activities). In this article, we analyze only the data related to the mobilization of the service provider's body. For the video clip on this subject, which lasts about 3 minutes, we edited 3 different sequences. In the first sequence, the service provider B described a pleasant and satisfying situation of hilling on a first plot. In the second sequence, she was engaged in more physical hilling on a plot where the soil was not pouring as well. Finally, in a third sequence, service provider A mentioned his different sensations while tilling a particular row of a plot presenting several types of soil.

These video clips were used with the third service provider C during an allo-confrontation interview (step 6). He was asked to comment spontaneously on specific elements of the video that were meaningful to him by pausing the video or rewinding it. During the viewing, the researcher observed the interviewee's behavior, facial expressions, posture and movements, and more or less focused gaze, to ask a question based on this behavior, about C's experience at that moment. The researcher also linked the behavior and the time code in the video. She asked service provider C questions about whether what he saw and heard reminded him of a similar situation that he could describe and comment on, how he positioned himself in relation to the comments of service providers A and B, and if he could describe, show or mime what he would do in a comparable situation.

2.2 Data analysis

2.2.1 Analysis of the hilling activity of a service provider

The analysis was carried out in two steps. First, in step 5, we transcribed the oral interactions between the service providers A or B and the researcher that were recorded during the self-confrontation interviews. Careful reading of the verbatim records enabled us to identify different themes commented by the service provider (service provider-winegrower relationship; mobilization of the service provider's body; equipment settings; relationship between the service provider with the plot or with the horse (education, training, divergent activities)). We marked the excerpts of the service provider's verbatim related to each theme, and then selected all those related to a particular theme that showed convergences or dissimilarities between service providers A and B. For example, we reported that service providers were using tactile cues to collect information about the nature and condition of the soil they were working on. We then analyzed the verbatim by identifying different areas of activity, mentioned by the actor, as developed in the course-of-action method and suggested by Poizat and San Martin (2020).

2.2.2 Comparison of the activity of three service providers

Step 7 consisted in a comparison of all three service providers. A three-part table was developed to match service provider C's allo-confrontation comments with service provider A’s or B's self-confrontation comments on a given situation (Figure 4), for the three sequences presented in the video clips. For each video clip sequence, the first part refers to the videos and describes precisely the service provider’s behavior during the hilling (actions, oral communications with the horse observable by an outsider). The second part of the table refers to the self-confrontation interview and contains the verbatim of the service provider A or B and the researcher. The third part of the table contains the verbatim of the service provider C and the researcher during the allo-confrontation interview. In the verbatim excerpts in Figure 4, two out of six areas of activity are documented ((1) Action/communication/sensation/emotion and (2) Knowledge). Thus, the cues and knowledge mobilized by service providers A and B, highlighted by the recording of their activity and their self-confrontation interviews, can be validated. Otherwise, the conditions of their appearance are specified during the allo-confrontation interview with a third service provider, C.

The excerpt in Figure 4 shows that the service provider C can relate to the comments made by the service provider B, to the effect that when the weight on the arms becomes too much, it is possible to help with the hip to take the weight off the arms and still keep the plow in the ground.

Part 1: Hilling situation			Part 2: Self-confrontation			Part 3: Allo-confrontation		
Time-code Hilling situation	Speaker	Action communication	Time-code Self-confrontation	Speaker	Transcription	Time-code Allo-confrontation	Speaker	Transcription
28s	Service provider B	[Service provider B holds her left arm against her hip and thigh][1]	13m24	Service provider B	This one here [pointing to his left hand on the screen], I'm holding it against my thigh[1] you see here I'm doing it.			[Start of the video clip on the service provider's body mobilization]
			13m28	Researcher	Yes			
			13m29	Service provider B	And then I get back on my feet, it's okay[1], but sometimes I lean against my hip and that helps me[3], you know.	11m08	Service provider C	[Service provider C nods as he listens to service provider B's words, researcher pauses the video] It happens to me too[3].
							Researcher	Really? To hold your arm?
							Service provider C	Yeah, sometimes you get tired so you use your hip to press the tool[3] [Service provider C does the movement with his right arm and right hip because he works on the right side of the row while service provider B works on the left side of the row)]. [Researcher restarts the video]
			13m38	Researcher	Oh yeah, it helps you push your plow to the vine?			
			13m42	Service provider B	Yeah well, like that, it takes the weight off my arms and I don't have to force it too much[1], it keeps it [the plow] in place[3].	11m27	Service provider C	[Service provider C nods as he listens to service provider B's words]

Caption:
Action, communication, sensation, emotion[1]
Knowledge[3]

Figure 4: Illustration of the verbatim analysis of the self and allo-confrontation interviews for each video clip sequence. First part describes the service provider's behavior during hilling (actions, oral communications with the horse observable by an outsider). Part 2 contains the verbatim of the service provider A or B and the researcher during the self-confrontation interview. Part 3 contains the verbatim of the service provider C and the researcher during the allo-confrontation interview. In this excerpt, the green color refers to the actions experienced and described by Service Provider B during the self-confrontation. The orange color describes the knowledge mentioned by Service Providers B and C in relation to the situation experienced or viewed.

2.2.3 Modeling the hilling activity with horse-powered traction

The whole research set-up contributes to a qualitative modeling of the activity observed and commented on by several actors through different modes of confrontation with the activity (self- and allo-confrontation interviews). The process illustrated in Figure 2 shows how the research device involves de-constructing the activity of a few service providers carrying out comparable operations (in this case, hilling) in different contexts (geographical areas, plots, partner horses, etc.) and sorting them into six areas. These areas of activity and in particular the knowledge mobilized in the action are then compared, to highlight the convergences or specificities between service providers. These steps contribute to the final step of identifying dimensions that allow service providers to structure and organize their hilling activity, resulting in a simplified model of complexity.

3 Results and discussion

3.1 Finding the best point of view to access the service providers' experience

The first step of the self-confrontation interview was to test, with the service providers, for the best angles from which to film the situation so that they would be able to comment on their experience. In the first self-confrontation interview, service provider A mentioned: "There we don't really see the work of the plow" (Figure 5A). The positioning of the GoPro on his chest did admittedly cause the image to move and the plowshare to leave the image frame. When leading the horse, his gaze was mainly "downwards to look at the soil turning" (Figure 1). He occasionally looked up to see the end of the row or to see if the horse was close to the worked row. "There [Figure 5A], we see more the straight movement of the horse". So, if the camera was primarily focused on the horse, it did not allow the service provider to access his experience. This situation led him to propose a new way of filming on the second day of observation, by holding the GoPro in his hand (Figure 5B and 5C). He took advantage of the presence of a trainee that day to film the situation himself. He tested two recording positions: in the next row behind the plow (Figure 5B) and in the same row in front of the plow (Figure 5C).

Figure 5: Testing three viewpoints on the situation. A. GOPRO located on the provider' chest, B. GOPRO held by the service provider on the other side of the worked vine row, C. GOPRO held by the service provider walking in front of the plow in the same row of vines worked.

Each view has its benefits and limitations. The view in Figure 5B allows one to see "all the action", the driver's gestures and the horse's position in the row, but is less precise regarding the interaction between the plowshare and the soil that is turned over. The view in Figure 5C is more precise regarding the movement of the soil on the moldboard plow but the horse is absent from the image. Filmed from these new angles with the GoPro (Figure 5B and 5C), the driver could easily put himself back into the dynamic situation by viewing two key elements: (1) the movement of the soil on the plowshare, and (2) his behavior in relation to his plow.

As Leblanc and Azema (2022) have demonstrated, the relevant point of view of video recording of actors' activity enables the actors to capture the most salient aspects of their activity. Here, we understood that the service provider A mainly used the visual cues resulting from the interaction between the plow iron and the soil, and in particular the dynamic movement of the soil that turns on the iron of the plow. Occasionally, he could also take visual cues from the position of the horse in the row (distance to the worked row – lateral movements–, or the distance to the end of the row – movement forwards). Furthermore, this phase, which facilitated the self-confrontation, also reflects the service providers' acceptance (Lallier 2009) of the researcher's presence to film "their realities" from their perspectives.

3.2 Value of the video to reveal the cues and knowledge mobilized by service providers

The view in Figure 5C allowed the service provider A to comment in detail on his activity while hilling in one row. The situation was as follows: the soil was accumulating in the moldboard, it was pushed and no longer turned (*focus*) by the plow. The soil ended up "going out in all directions", including in the middle of the row whereas the service provider wanted to steer it only close to the vine plant to form the mound (*intention*). He therefore had to stop the horse to remove the soil from the moldboard (*action*), which increased his fatigue and that of his horse. In this situation, he adjusted his hand movements (*action*) to help clear the soil from the moldboard of the plow (*intention*). "You see the movement? It [The soil] is turning a little better there (*focus*). “Tac-tac” [mimicking the gesture], it helps the soil not to stick too much, because when the soil is stuck [to the moldboard], it's over [you have to stop to clean the moldboard]” (*knowledge*). The service provider also used gestures during the self-confrontation interview to describe his action. The researcher relied on these gestures during the interview to continue investigating the service provider’s activity and to help him formulate what had become so embodied that he no longer even mentioned it, as he no longer paid attention to it.

The service provider’s detailed description of this situation is facilitated by the video which clearly shows the dynamic link between his perception of the soil that was starting to stick to his moldboard and his hand movements to turn the soil. Similarly, as he was progressing along the row with the horse, he perceived the changes in soil texture or the arrival of stones in certain parts of the row thanks to the sound generated by the soil’s contact with the moldboard. These elements, present in the work situation and highlighted in the recording with the help of the researcher's questions, allowed the service provider, during the self-confrontation interview, to evoke his sensations and his knowledge mobilized in the action. These results confirm the assertion of Leblanc and Azema (2022) who consider that "The film allows us to understand the details of the gestures, the movements, the distances and the temporal flow of the practice". Mollo and Falzon (2004) also point out that the use of video recordings avoids the filtering or distortion that the researcher might apply to the data when taking notes during the observation of the situation, by selecting only certain information to have the service provider comment on.

Thus, we show through this self-confrontation interview that the visual cues are not the only ones used by the service provider to understand the soil conditions and adjust their practice. Other indicators are mobilized, such as those linked to touch through the sleeves of his plow (sensation of soil slipping, sticking), and sounds.

3.3 Cues and knowledge mobilized during hilling

The activity of the two service providers A and B, compared to that of service provider C, made it possible to highlight cues from the body or from the relationship with the horse, and knowledge mobilized in different hilling situations. The situations observed on recorded hilling days additionally made it possible to highlight different body and relational cues with the horse used by each of the providers A and B, some being common, other specific. To understand whether these cues were shared by other service providers and to identify the conditions of mobilization of certain cues specific to a particular situation, we used the allo-confrontation interview to indirectly access the activity of service provider C. For instance, the three service providers recognized a hilling situation as occurring in optimal or degraded conditions, based on variations in visual, tactile, and/or sound cues or variations in the relationship with the horse (Table 1). Thus, our method allowed us to specify the conditions of appearance of body or relational cues mobilized in a situation (linked to a specific configuration of the plot, or to the nature of the soil, etc.). The visual cues used by service providers varied according to the soil's interaction with the plow. The soil can form a homogeneous mound with a friable consistency along the row in optimal conditions, or it can go towards the middle of the row or form large blocks in certain places in degraded conditions. The behavior of the horse at work, in particular its walking speed, its fatigue and the speed of its response to the service provider's prompts was also an indication of the progress of the intervention in optimal or degraded conditions.

Table 1: List of body and relational cues with the horse used by service providers A, B and C during hilling activity, according to the optimal or degraded hilling conditions. This list is derived from inferences made by the researcher based on the comparison of individual service providers' activities.

Body cues	Optimal hilling conditions	Degraded hilling conditions
Visual Cues	Homogeneous soil mound under the row	Soil moving to the middle of the row
		Soil overflowing on the other side of the row of vines worked, on the return path of the hilling
		Soil turning less on the plowshare
	Loose, friable, granular soil	Soil sticking to the plowshare and/or wheel
		Soil forming large blocks
		Smoothing of the soil at the bottom of the furrow formed during hilling
Tactile cues	Very little action on the plow "plowing by itself"	Heaviness in the hands and fatigue in the arms
	Softness and suppleness of the soil when no stones	
	Sensation of cracking felt through the plow when there are some stones	Joint pain, hand injuries
Sound cues	Specific song for each plot for a given tool	
Relational cues with the horse	Smooth and fluid communication	Repeated communications using voice and reins
	Favorable response of the horse to the service provider's vocal prompts without the use of reins	
	Understanding each other without using the voice or the reins	
	Horse that is doing well and wants to work	Tired horse
	Horse at the right pace	The horse speed is too high

The cues taken into consideration by service providers during their activity are thus numerous and perceived through different senses. As discussed by Toffolini et al. (2016), farmers mobilize a library of visual references (for example, homogeneous or heterogeneous soil mound under the row) to interpret the conditions of their agrosystem and construct an understanding of its functioning. In an experimental study, Cerf et al. (1998) presented photos of the soil and its texture to cereal farmers and asked them how they decided to intervene on the soil to prepare a seed bed. The authors demonstrated the importance of the viewpoint of the photograph in enabling the farmer to understand the situation. In our study, not only were service providers involved in choosing the point of view that allowed them to have cues to understand their soil conditions (see 3.1), but the use of video instead of photographs also captured the dynamics of soil movement as it interacted with the tool (3.2). Thus, criteria that are difficult to assess from photographs (e.g. soil moisture) were hardly mentioned by farmers in Cerf et al. (1998), when they are in fact crucial for deciding whether or not to intervene on the soil. In our study, thanks to the use of video, many visual cues related to the movement of the soil and its dynamic interaction with the tool along the row (accumulation of soil, soil turning less well, formation of plates, etc.) allowed service providers to estimate whether or not the soil was too wet to intervene.

The activity of horse-powered tillage accentuates the proximity of the service provider to the soil, compared to tillage by tractor. As service providers walk behind the tool, they directly visualize the movement of the soil on the plow in front of them. Moreover, when nuisances due to the functioning of the tractor engine (noise, vibrations, odor) are removed, service providers mobilize their other senses more easily. Thus, tactile and sound cues, as well as relational cues with the horse, are mobilized by service providers to interpret the situation in which they are engaged. They easily perceived the condition of their horse as "doing well" or "being tired", without detailing it much at first. When their relationship with their horse was long-standing and they had repeatedly worked on known plots and operations, they sometimes described the relationship as "instinctive", that is, not requiring the use of their voice or conventional means of communication such as ropes or leather straps, webbing or synthetic material between the horse’s mouth and the driver’s hand. Despret (2013) defines embodied empathy as "the process by which one delegates to one's body a question, or a problem, that matters and that involves other beings' bodies." The actions of the service provider were embodied; in other words, he no longer paid attention to them and these actions were “prediscursive, preconceptual, profoundly gestural” (Petitmengin 2006). This relationship or "mutually created language" (Brandt 2004) between horse and service provider allowed them to create a shared sensibility and thus increase their libraries of available bodily cues.

The analysis of the verbatims from the self- and allo-confrontation interviews yielded a range of knowledge on the use of these bodily and relational cues allowing service providers to understand the situation and adjust their intervention on the soil (Table 2). For example, the formation of soil blocks when hilling at the beginning of winter can have greater or lesser consequences, depending on the intervention area. Service providers B and C explain for instance that the winter frost will help transform these blocks into friable soil at the end of the winter. Areas where the temperature may drop below zero degrees in winter do not benefit from this effect.

Table 2: Knowledge allowing service providers to understand the situation and adjust their intervention. The information is split according to optimal and degraded hilling conditions (column), and divided according to knowledge on soil behavior, health and energy of the service provider, and horse behavior (lines).

Knowledge mobilized during hilling	**Optimal hilling conditions**	**Degraded hilling conditions**
Soil behavior	The frost helps to destroy blocks formed during hilling	
		On a transversal slope, the soil falls towards the middle of the row
	The presence of some pebbles can help the soil to fall off the plowing iron	Soil with many stones causes more vibrations in the service provider's body
	Sandy soil, softer, easy to work	Clay-limestone soil more tiring and harder to work
	Damp, homogeneous and supple soil	Sticky earth preventing the soil from turning properly on the moldboard
Health and energy of service provider	Plow adjustments to reduce fatigue Choice of a tool adapted to the plot (weight of the plow, size of the iron, etc.) Choice of the starting side of the work. Example: on a plot with a transversal slope, start with the row at the bottom of the slope to bring up the soil Wait until the soil is sufficiently dry	
Horse behavior	Experienced and trained horse	Young, unprepared or inexperienced horse

Thus, elements linked to the agrosystem and its environment will be favorable or not to the emergence of degraded hilling situations. Service providers will be able to adjust their activity by intervening in different settings (tools, intervention window, etc.), but if they have several horses with more or less experience, they will also choose the horse according to the anticipated difficulty of an intervention.

3.4 Qualitative modeling of the activity to build video for training

During the self- and allo-confrontation interviews with the service providers, we wanted them to comment on their activity as if they were in the situation without analyzing it afterwards. However, confrontation with their own activity or that of a peer through a video recording spontaneously led them to reflection on their own practice at certain moments. For example, during the allo-confrontation interview, the service provider C was confronted with the service provider B's practice regarding requests to her horse to turn around at the end of the row. The service provider B did not use either voice or guides to ask her experienced horse to turn at the end of the row; her horse spontaneously turned around and stopped at the beginning of the next row. In the same situation at the end of the row, the service provider C explained that he himself "leaves little room for initiative," "I will decide when it [his horse] will turn around and/or possibly stop for a break at the end of the row." The fact that the service provider B had installed an "automatism" in her horse's behavior at the end of the row and that she no longer needed to use her voice or the guides to make it turn around led the service provider C to reflect on his own way of acting with his horse at the end of the row: "Somehow, they go further than I do and I think that what they have developed is more intelligent than what I have done, I might expect too much [from my horse], I might be too directive".

In literature, the confrontation with the activity of peers thanks to the use of video clips has shown real advantages as a training modality (Leblanc and Ria 2014; Leblanc 2018). Individuals undergoing training, confronted with the real activity of peers facing the same difficulties and problems as they do in their trials and errors, will more easily evoke their own difficulties and doubts in training. The learners have access, thanks to video clips, to the adjustments of the activity implemented by others to try to improve their own situations. They thus spontaneously engage in mimetic behavior favorable to reflexivity and they project themselves in future experiments for their own activity. According to the winegrowers, there is currently not enough training available in this alternative practice of horse-powered soil tillage, which limits its development (IFCE and IFV 2021). However, service providers have significant expertise in this practice due to the frequency of implementation on a variety of plots, which could be of interest to winegrowers wishing to do their own tillage with a horse. Thus, this access to service providers' experience will make it possible to convey the typical elements of the activity of horse-powered tillage to learners prior to their experience of it, to inspire them and facilitate their learning. As we have shown, digital tools can be a valuable source of learning thanks to the visibility of service provider's implicit activity like body cues and relational cues with the horse, and associated knowledge to understand the intervention situation. The use of easy-to-use and ergonomic cognitive resources in consulting and training can be a real asset. An environment of video clips built from the modeling of service providers' work would allow other service providers, or even winegrowers who themselves would like to experiment with tillage with horses, to select and arrange useful knowledge in their own way (Gaudin et al. 2015). According to Berthoz (2009), living beings select a few criteria to adapt efficiently to/in hypercomplex environments. Identifying the dimensions that structure and organize the activity can simplify the complexity by making a provisional and qualitative model of the activity. From the analysis of the hilling activity of the three service providers, we can represent these dimensions as axes in tension that the service provider tries to balance in order to act (Figure 6).

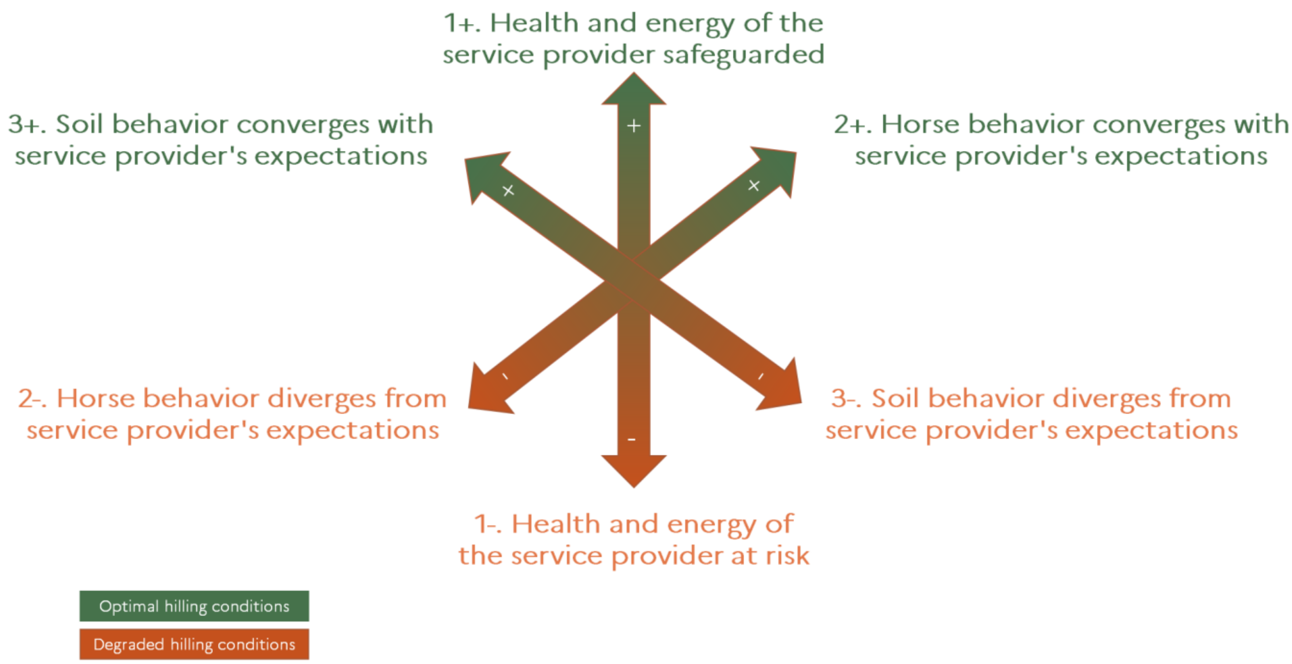

Figure 6: Qualitative model of hilling activity by service provision in equine traction, organized around 3 main axes in tension (1. The health and energy of the service provider, 2. Horse behavior, 3. Soil behavior). Green color refers to optimal hilling conditions, and orange to degraded hilling conditions.

This first analysis led us to identify three main organizing axes of the hilling activity carried out by the service providers, which are linked to one another. For example, in Figure 6, we propose a first representation of this model. The first axis concerned the behavior of the soil during the plowing operation, as assessed by the service provider. The service providers assess the behavior of the soil according to a scale ranging from convergent with his expectations in optimal conditions, to divergent from his expectations in degraded conditions according to several mainly visual indices. The three service providers' fundamental concern is to carry out a hilling that is both aesthetic (soil not scattered over the whole plot) and efficient, in particular in terms of burying the weeds and the shape of the hilling (homogeneous, etc.) to facilitate future ridge plowing operation. The data constructed during this study could highlight, in video clips, the visual cues and associated knowledge to assess the conditions of the activity. A second axis is likewise related to the behavior of the horse, to promote a fluid relationship and continuous work without the need to repeat orders several times and without successive stops leading to additional fatigue for the horse. The data constructed during this study could highlight, in video clips, the cues related to the evaluation of the horse's condition and ability to perform the work, and thus allow to adjust the conditions of their work if necessary. For example, the service providers would choose a simple situation (plot without slope, sandy soil, no stones, etc.) for their young inexperienced horse. A third axis is related to the health and energy of the service providers themselves. Even if they are able to continue working when they feel pain, the service provider activity implies an intense professional commitment during seasonal peaks, with daily physical work. Therefore, ways must be found to facilitate their work. The data constructed during this study could reveal, in video clips, the knowledge associated with the choice and settings of tools adapted to the plot to be worked or the working methods for more complex plot configurations (double slope, etc.).

This qualitative modeling aims to encourage users to reflect on their own practices and to evolve as they do so (Azema and Leblanc 2021). This model of the hilling activity is not static; it is intended to evolve through the construction of new research data on the transformation of these activities in relation to their dynamic and complex environments. The process of description and comprehension of case studies ends once the research reaches theoretical saturation, described as "[when] one has then more or less [...] gone through the range of strategies [or possible situations] relative to a particular arena" (De Sardan 1995). Other video recordings of the work followed by self-confrontation interviews in other viticultural areas or in other soil tillage activities such as ridge plowing followed by other allo-confrontation interviews will thus be necessary to strengthen our analyses and qualitative modeling.

4 Conclusion

This article presents two main results. First, video recordings were used to identify and then compare the knowledge and cues mobilized by service providers while performing their work. Self-confrontation interviews helped service providers to comment on the invisible part of their activity, namely knowledge, while allo-confrontation interviews allowed for a rise in genericity by highlighting either typical dimensions organizing the activity or, on the contrary, the particularities of several service providers' activities in relation to their specific context. The identification of these typical and specific dimensions can be enhanced through an evolutionary and qualitative modeling of the activity aimed at sharing the knowledge of experienced service providers in training or consulting. Thus, based on these results, we consider that the allo-confrontation interviews could also be conducted in training or consulting situations, based on a platform of video clips organized according to these typical dimensions of the activity. The allo-confrontation interviews would then engage the learners in reflexivity leading them to question their practice or to experiment with new practices that may have similarities with other soil maintenance practices that the winegrowers are familiar with (especially with a tractor). Secondly, the mobilization of such device based on self- and allo-confrontation is quite rare in agronomy and it enabled us to build original insights, especially on the various information collected and analyzed by the horse-leader. Thanks to the conservation of the dynamic flow of the activity and the sound, the video recordings allowed service providers to evoke the bodily and relational knowledge with their horses that helps them to adjust their activity permanently. As the sensory information arrives simultaneously in the continuous flow of the activity and by different modalities (sight, smell, touch, hearing), the video recordings facilitate the selection and analysis of significant moments for the actor during the self- or allo-confrontation interview. As future perspectives, we will continue modeling the activity by looking at another soil tillage operation, which is plowing the ridges. This will also allow us to identify particularities of operations on the soil. To test and increase the genericity of our results, we will involve new service providers with similar methods. Finally, and more generally, we believe that the implementation of our approach will allow for the integration of farmers' empirical knowledge into scientific agronomic knowledge and thus reduce the gaps, and favor synergies between the knowledge produced by science and that experimented in the field by the farmers themselves. Agronomists can contribute to bringing the empirical knowledge of farmers to light by appropriating the methodology of self- and allo-confrontation interviews. Moreover, the participation of farmers in the construction of the research system will make it possible to improve the performance of research, including support for changes in practices in favor of agroecology. The main originality of our research stands in the characterization of the embodied knowledge mobilized during the situation of plowing with a horse. To study the step-by-step design of the agrosystem by winegrowers and support their transition, next studies should focus on the interactions between plowman and winegrower, and on the use of videos for training and learning of future horse users.

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Declarations

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Conflicts of interest/Competing interests

The authors declare that they have no conflict of interests.

Ethics approval

All research procedures involving human participants were in accordance with research ethical standards at the date of the study. No experiments on horses were performed in this study.

Consent to participate

Verbal informed consent was obtained from all individual participants included in the study.

Consent for publication

Verbal informed consent was obtained from all individual participants for publication of the results.

Availability of data and material

The datasets analyzed during the current study are available from the corresponding author on reasonable request. This excludes the raw documents from interviews, which contain personal information on the participants.

Code availability

Not applicable

Authors' contributions

Conceptualization and methodology, C.B., L.H., M.N. and S.L.; Resources and access to farmers, C.B.: Investigation, C.B.; Writing — original draft, C.B.; Writing — review and editing, L.H., M.N. and S.L.

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