

# The indexicality of measuring: Osteometric practices in the forensic lab

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## *Abstract*

Measuring is a practice that characterizes both everyday and professional activities, and that relies on the skilled situated use of tools, materialities, language and embodied conducts. This paper deals with practices of measuring in a forensic laboratory, in which experts measure bones as part of their ordinary work, consisting in the detailed examination of human remains for establishing the bio-anatomical profile of the individual to whom they belong to. The paper adopts an EMCA approach inspired by the work of Mike Lynch on scientific laboratories and legal settings, and offers a video and multimodal analysis of expert interactions in a forensic laboratory in Brazil, specialized in the identification of disappeared activists during the dictatorship of 1964–1988. In particular, the study shows how measuring of bones, as part of post-mortem inquiries, constitutes a local and collective accomplishment, possibly generating disagreements and controversies. It also discusses how the experts engaging in measuring bones encounter practical problems that reveal the indexicality of measuring practices and their situated contingencies. In this way, the paper offers an EMCA contribution to studies of the production of scientific knowledge and forensic evidence, the situated embodied use of artefacts, and the multimodal and multisensorial engagement with human remains.

## 1. INTRODUCTION

Measuring is a set of practices that happens everywhere in everyday life, from cooking to choosing the right frame for hanging a painting, as well as in professional and scientific life. In the laboratory, measuring and producing quantitative measures are often considered the hallmark of precision and objectivity. However, what this forgets is that measuring is a situated practice, relying on embodied manipulations of measuring tools and objects to be measured, in ways that affect not only how results are produced but also the results themselves. Taking into account the embodied practices that constitute measuring, reveals the relevance and consequ-

entiality of the detailed ways of situatedly manipulating objects for the measure that will be finally produced—in brief, it reveals the indexicality of measuring generated by all the contingencies that can affect measuring here and now.

This study deals with measuring the length of femurs in a lab of forensic anthropology where a team of professionals is examining human remains in order to proceed to an estimation, based on calculations, of the stature of the person the bones are coming from. The team is involved in a mission consisting of describing the bones of unknown disappeared persons during the Brazilian dictatorship and eventually identifying them.

The fragment of forensic activity we concentrate on here concerns the measure of bones. It is a perspicuous case for an ethnomethodological and conversation analytic study of measuring, in the sense that the participants do not merely measure but engage in a variety of practices related to and constituting measuring: questioning the procedure to be adopted for measuring, comparing two femurs of the same person by holding them side by side, and qualitatively discovering that they are very different, measuring them with an osteometric table and obtaining different measures, double checking the measure with another colleague, and finally adopting a definitive measure. Although the size of the femurs of a person might show some difference, an important divergence between the length of two femurs that have been presumably attributed to the same individual (on the basis of other examinations and evidence) is potentially puzzling for the forensic experts, given that it might cast some doubts about this previous attribution and even index an error. Moreover, although the measures might vary, they are introduced in further calculations and this might have consequences on what final results aim to reveal (here the stature of the person). In the absence of any information about the anonymous disappeared individual, exact measures and descriptions are the only way to produce fragment by fragment a global picture that will hopefully lead to the (re) identification of the person.

These issues show that measuring is not an autonomous practice: it is embedded in a web of possible relevancies provided by the overall activity, the global project, and the uncertainties generated by the obscure context of bone retrieval. Measuring is also related to the professional practices and routines of the team of forensic anthropologists, which are also affected by other contingencies, such as modes of collaboration, precarious work conditions, and disciplinary affiliations of its members. By focusing on the details of the ongoing work, the analysis reveals the complex web of features that make the indexicality of measuring and their consequentiality for the specific project at hand.

Moreover, by focusing on the details of the work—the *how* and the *what* of the work—in the perspective of multimodal EMCA and using video recordings, the analysis reveals both the professional expertise of the team members and the unique adequacy needed to analyze them. In order to understand the video-recorded details of the practice, the analyst has to see and understand the relevancies that the participants orient to in the lab and be able to recognize them on the video record, building the coherence between these two phenomenal fields. In order to tackle these relevancies, and to constitute the unique adequacy of our professional gaze on the video data, we proceeded to a re-enactment of the very same measure done by the forensic anthropologists, on and with the same measured objects. By generating some measu-

res ourselves, we experienced the uncertainties of the measuring practices and participated in the triple-check of the results finally considered as definitive by the participants.

## 2. BACKGROUND

This study of measuring in forensic anthropology addresses several issues in ethnomethodology and conversation analysis (EMCA). First, it considers measuring as a situated practice, anchored in the routines of the lab, and characterized by its witnessability, instructability and indexicality. Second, it describes the work practices of a forensic team, in which measuring concerns human remains and their specific qualities. Third, this includes the question of how the actions involved in measuring bones are accountable, recognizable, and witnessable, for the co-participants on the one hand and for the researchers on the other hand, raising issues in the unique adequacy necessary to study this work.

Largely addressed in methodological normative discussions, and despite some interest in “folk” measuring practices in anthropology (e.g., Lave 1988), measuring practices as a *topic* of analysis remains largely understudied. Despite abundant discussions about quantification and calculation in STS, the very embodied practices through which measuring is performed are still neglected (although see Muniesa and Trébuchet-Breitwiller 2010 on the body as an instrument of measurement in the perfume industry). Lynch’s observation, 30 years ago, that most of the literature “takes for granted the ‘astonishing fact’ that measurements in the physical sciences correspond precisely to their objective references”, ignoring “how such correspondences are achieved in situated scientific work” (1991, 78) is still valid. Focusing on measuring as a practical situated accomplishment, this paper follows Lynch’s advice to study ordinary acts of measuring, that is, “how members’ conduct measuring activities by producing local judgements on the practical adequacy, accuracy, and appropriate correspondence between measuring devices and measured phenomena” (1991, 86). Using video recordings of measuring practices, we engage in such analysis, revealing the routine methodic aspects but also the difficulties, puzzles, incidents that can affect such work (cf. Sormani 2014 on experimental physics). In particular, they reveal the indexicality of measuring: far from being a precise practice controlled by following a prescribed procedure and technique, measuring, like all practices, is an irremediably situated achievement, sensitive to the indexicality of the ongoing activity and its broader context.

Measuring is among the practices constitutive of many work settings, professional, expert and scientific. In our case, we focus on a forensic laboratory, casting some light on the ordinary practices of forensic experts. Forensic anthropology and archeology have raised considerable interest in the last decade, also related to increasing debates about human remains (Anstett and Dreyfus 2015). This has produced self-reflections within the discipline (Snow 1982) as well as historical studies about its emergence and changes, often bound to tragic national histories, marked by war, state violence, and mass killings—such as in South America, where forensic expertise emerged after the decline of dictatorial regimes at the end of XXth Century, and as part of restorative justice and crime investigations (Dutrénit Bielous 2020; Calmon 2020). This has also produced ethnographic studies about the discipline, reflecting on the complex contexts in which it operates and intervenes (Crossland and Joyce 2015), the

way in which evidence is provided (Crossland 2013), and more seldomly, its situated practices (see the first-person ethnographies of learning forensic anthropology in Guatemala and Argentina, Sanford 2005 and Hagerty 2023). In the field of EMCA, practices involving dead bodies and human remains are still practically nonexistent. Analyses of forensic work are largely absent, with the notable exception of Lynch et al. (2008) study of the use of DNA in trials, against other forensic methods of providing evidence (see also Lynch 2013). This study reveals the fascination for objective factual proofs in the realm of law, as well as the way in which the objectivity of DNA analyses is achieved in situ, within organizational scientific and bureaucratic practical routines.

This chapter pursues a double contribution in fields addressed by Lynch (1991; 2013) in his career, bringing together the study of measurement as a situated practice and the study of forensic sciences within an EMCA perspective. In particular, we address the situated embodied practices that accomplish measuring as an expert situated action in the forensic lab, taking into account its scientific and normative accountability, its witnessability for other team members, the way they deal collectively with uncertainties and inconsistencies, and they finally achieve stabilized measures as an agreed result.

### 3. DATA

The analysis is based on a project pursuing a praxeological and interactional study of the embodied, sensorial, verbal, and epistemic practices of forensic experts in a laboratory involved in the investigation of human remains of *desaparecidos* of the Brazilian dictatorship. The laboratory provides for various forensic analyses of bones of citizens and activists retrieved in clandestine mass graves created by the dictatorial regime to disappear, dismember and disperse the bodies of political opponents. While institutionally hosted by a major university in Brazil, the laboratory also connects with families of disappeared persons and associations fighting for their identification and memory.

The current project documents the work of the forensic team on bones found in a box retrieved close to a site of torture during the dictatorship, investigated as particularly challenging because the remains of several uncomplete skeletons of unknown individuals are mixed, put together in unknown circumstances. The difficult task of the forensic team consists of finding out how many individuals are partially contained in the box, providing for their biological profile (concerning sex, age, stature) and possibly for their personal identification.

We have continuously video-recorded the work of the team since the arrival of the box in the lab. This enables us to follow the progression of the work, as well as its difficulties, challenges and obstacles. This also enables us to focus on the praxeological details of the work, consisting of manipulating the bones, looking and touching them, in order to describe them according to various techniques. In this study, we focus on the measurement of femurs, which provides important data for the calculation of the stature. In turn, this focus enables us to reflect on measuring practices, their methodic and their indexical character, their procedurality, instructability, intersubjectivity, and normativity.

Moreover, this particular focus on the details of measuring, the manipulations of the bones on the osteometric table, the uncertainty of the practice and the results, raises questions

about the public accountability of measuring in two senses: on the one hand, the accountability the practices have for the team members—observable in the way they orient to the work of their colleagues, oversee, witness and monitor it, instruct it, and join it. On the other hand, we discuss the accountability these practices have for us as analysts, referring to the concept of “adequacy requirement of methods”, that is, the requirement for the researchers themselves to fully understand and, if possible, become a vulgarly competent practitioner of the activity studied (Garfinkel and Wieder 1992, 182–84; Garfinkel 2002, 175; Smith 2024). In our case, the requirement concerns all the steps of the research: how to film the work, how to transcribe relevant details, how to identify, recognize and interpret them, and how to ascribe accountable actions to movements. There are multiple ways to assemble this unique adequacy: by engaging in fieldwork, by repeatedly carefully watching the videos, by selecting the elements to transcribe and their description and categorization, and by developing their analysis, eventually with the help of the participants. In this chapter, we reflect on the unique adequacy requirement by showing its relevance in the multimodal analysis of detailed embodied movements, and we further secure it by engaging in the practice of re-enacting (Sormani 2020) the very same conducts as the ones studied in the video, redoing the same action with the same bones, together with one of the participants as instructor (see §4.2).

#### 4. ANALYSIS

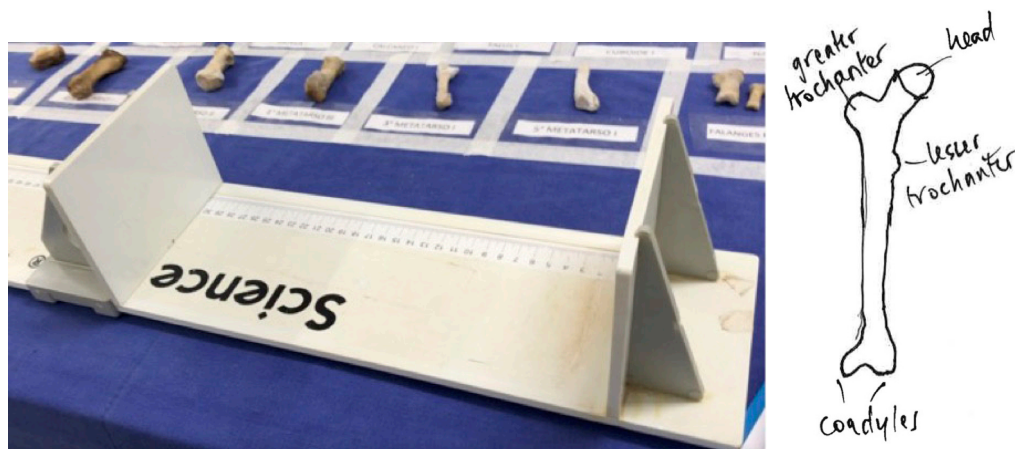
The team members are working silently around the table on which the bones are disposed, each of them busy with a distinct bone/series of bones (fig. 1). In particular, Carola is engaged in the measurement of the femurs, which will generate two puzzles. The first one (§4.1) concerns the way of measuring, that is, the method to use. There are two methods available, and Carola discovers/remembers that while handling the femur for doing the first measure. So, the first puzzle emerges while initiating measuring in an embodied way. It is solved by asking the colleagues which technique they use (as it turns out that Carola works also in a different institution that uses a different method than in the current team). The second puzzle (§4.3) concerns the results of measuring, the measures themselves. After having agreed on the method to use, Carola does a series of measures. After femurs that have been categorized as belonging to different individuals, she measures the two only ones that have been attributed to the same individual, through previous separate analyses. After the measure of the first femur, the second occasions a puzzle concerning the discrepancy between their resulting sizes (against the expectation that the size should be similar, given that the femurs have been attributed to the same individual). This discrepancy is checked in various ways, which again involve the colleagues. Finally, the puzzle is (dis)solved by re-doing the measure and finding less divergent results. These two puzzles concern key aspects of the indexicality of measuring: the method to use, implicating the adequate manipulation of the bone on the osteometric table, and the obtained results, implicating some expectations that generate double and triple checks. The troubles encountered during the work show that indexicality is indeed a member’s problem; moreover, troubled details also point at a larger context of their activity, making salient broad-

der issues such as working conditions and the historical context of dealing with human remains disassembled and disseminated in a violent past.

#### *4.1. Measuring: establishing which method to use*

Measuring is an embodied practice, building on the detailed arrangement of bodies, objects to measure, and measuring tools. This detailed arrangement of the work ecology is often not instructed in the formal procedures and the manuals, but works as an instructional configuration (Garfinkel 2002, 213; Ivarsson and Falkenberg 2024, 58). The arrangement is a practical and situated accomplishment; its validity and the ‘objectivity’ of the results it produces are achieved through forms of intersubjective agreement between the participants, collectively engaging in, monitoring, and checking the ongoing measuring activity.

The core of the activity consists in using an osteometric table (Image 1) to measure the femur’s length. This involves a specific positioning of the bone, considering its anatomy (Image 2).



*Image 1 & 2: Osteometric table (source: authors) and femur (drawing: authors)*

The osteometric table is a device that incorporates a ruler between two extremities, one of which is fixed (see fig 1 on the right) and the other is mobile (fig. 1 on the left). Once positioned adequately on the table, the bone is measured by “closing” the mobile part of the table and reading the corresponding measure. As we will see, the osteometric table does not (fully) constrain the way the bone is positioned on it, and indeed the person measuring it manipulates it in various ways to establish it. This can be done by reference to two measurement methods, which will be discussed in the following fragment. The first, anatomic, method consists of pressing the two epicondyles (inferior part of the femur, see fig. 2) on the fixed extremity of the table: this defines the position of the bone that is then measured by pushing the mobile extremity of the table on the trochanter. By contrast, the second, maximal (or mathematical), method consists of moving the bone on the table searching for its maximal length.

In this section, we discuss how the participants find an agreement about the method to be used (§4.1.1) and the way it is defined and instructed in and through the use of a manual



(§4.1.2). In the next section (§4.2), we come back to the details of measuring in their re-enactment. Then (§4.3) we show how the participants deal with divergent results produced by the agreed-upon method.

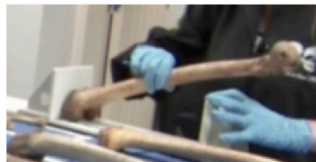
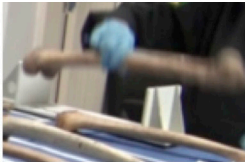
#### 4.1.1. The first formulation of the problem: choosing between two measuring methods

The choice between the two methods of measurement emerges from the ongoing work. Carola has agreed to measure the length of all the femurs, a bone that features centrally in the calculation of the stature. The first moments of the activity are solitary and silent: Carola moves towards the osteometric table, while her colleagues work on distinct tasks, all around the table where the bones of the “case” are anatomically disposed (fig.1).

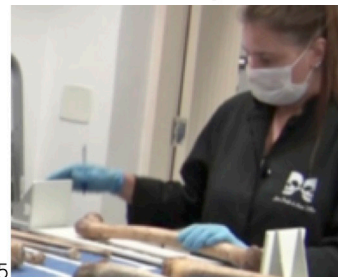
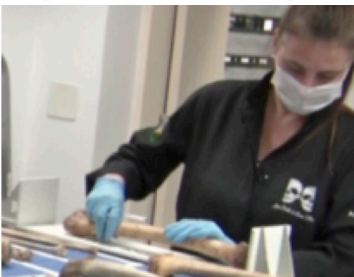
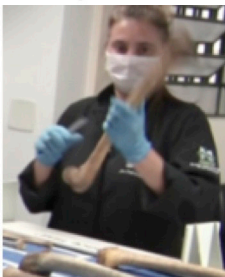
##### *Extract 1 (lines 1–3)*



1                    #£    (2)   #       £    #    (3)                    £                    (2)                    £  
 car                £takes femur£puts on osteom.t£checks R/mobile part£  
 fig                #fig.1   #fig.2   #fig.3



2                    £                    #    (3)                    £    (3)#    £    (2)                    £                    (1.5)   #  
 car                £inverts f orient£positMax£positAnat£RH on mobile part->  
 fig                #fig.4                    #fig.5                    fig.6#



3    CAR                6: £  
 ->£readjusts fêmur w both hands->

Carola grasps the first femur to be measured (fig.2: on the desk, this is the femur in the second row; since the first one, closer to the osteometric table, has been discarded as not measurable). She puts the femur on the table (fig.3). However, this initial position, which keeps the same

orientation as the bone on the desk, is then corrected, by inverting it in the opposite direction (fig.4). This correction enables her to put the condyles towards the fixed part of the measuring table: this projects the relevance of their position for the measure. Indeed, Carola now carefully moves the femur on the osteometric table, while looking at its fixed extremity (fig.5); then she slightly adjusts it. These readjustments might seem minimal but correspond to a change from what will be later called the mathematical/maximal position into the anatomical position. By means of these small adjustments, Carola is exploring two possible measurement methods. Finally, her right hand moves to the mobile extremity of the table (fig.6), projecting to close it: this projects the measure to be taken. However, at that moment she suspends her movement, holds her hand on the extremity, and produces a loud *ó:/‘look’* (3).

Our description of her movements shows the possible options she encounters, concerning both the orientation of the femur and its contact with the extremities of the table. Her embodied manipulations show an attention to the bone as well as the table as oriented objects which have asymmetric parts. These movements, their details and the relevancies of the manipulated objects they orient to display a skillful engagement in the activity of measuring, revealing the multiple relevancies addressed in this engagement. In turn, these movements are challenging for us as analysts, pointing at multiple possibilities of referentially describing them in the transcript and the analysis, and at the unique adequacy that their relevant praxeological description supposes. Carola could be described as merely manipulating the bone over the table (generic description, low granularity), as slightly moving the bone on the table (deeper granularity, but still a generic description), or as orienting to the exact position of the condyles relatively to the fixed extremity of the table in moving from a maximal to an anatomic measurement procedure (professional endogenous description with relevant granularity). In this paper, we aim at the latter description, closer to the endogenous perspective of the participants and respecting the unique adequacy requirement (further discussed in §4.2).

The initiation of a new sequence of interaction with her colleagues occasions the formulation and discussion of these differentiated movements.

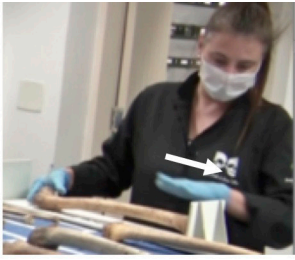
*Extract 2 (lines 4–23)*

```

4          (0.3)
5  CAR      $só para saber (0.9) recor- fcoisar• que
             just to know (0.9) rememb- do      that
             $looks at Lextremity->
                                     ->f
ali
6          tem fque: (0.4) vocês #apofiam$ também fos doisf
             that has to (0.4) you press      also the two
             fLH gest twd extr-----f      fLH gestf
                                     $looks at ALI->
fig
                                     #fig.7

```





```

7          *£trocanteres* aqui:, £e puxa a tábua?
          trochanters. here and push the table
ali        *nods-----*
          £estabilizes the femor£closes table--£
8          (0.2)
9 CAR      £é is+so?
          Is (it) that
tan        +looks at CAR->
10         £          (1.4) # £
          £opens both hands£
fig        #fig.8

```



11 CAR lá fno IMEDEL a gente faz assim.#  
 there in the Institute of Legal MEDicine they do so  
 fpoints at Lextrem->  
 fig #fig.9



12 (0.7) \* (0.5)  
ali \*turns to manual and flips pages->  
13 CAR não lembro bem como fque era aqui.  
I don't quite remember how it was here  
->f  
14 (0.7)  
15 ALI tá. é bom rever na:  
PRT it's good to look again in the  
16 (0.4)



by Alice (15) who accounts for the search through the manual—so that the mobilization of the manual is oriented to as a response to a lack of memory (explicit in the use of the verb *lembrar*/‘to remember’ 13 but also of the verb *rever*/‘to look again at’, ‘to double check’ 15, referring to something they both knew but have now forgotten, in a context in which Carola has not worked with that team for some time and the pandemics and political circumstances have delayed the project for a long time too).

Carola also adds an alternative (17), *ou é a má:xima distân-*/‘or it’s the maximal distan-’, referring to the alternative technique of measuring, which they call the *maximal distance* or *mathematical measure*. This alternative comes rather late, and by contrast with the first method, it is not demonstrated, but only mentioned. While Tanja begins to flip through her manual too, Alice aligns with Carola (18–19), by producing an account, referring to the use of distinct calculations (‘formulae’) corresponding to distinct techniques of measuring. Both align with the fact that the choice of one method over the other is consequential for adopting different models of calculation, and hence results. In this way, Carola’s problem and task become a collective issue that all participants progressively engage with.

#### 4.1.2. Establishing the manual as instruction

Manuals are a typical example of instructions (Garfinkel 2002). However, there is a big gap between the manual as an inert object, and the manual as mobilized in various practices using it *in situ* for and within the task at hand. Garfinkel highlights how the diagrammatic instruction for assembling a furniture acquires its intelligibility only in and through the course of the work. The situated moment in which colleagues reach the manual and flip through it shows their orientation to it as possibly providing the answer to Carola’s initial question. But its mobilization is not straightforward: it occasions not only the search for the right page to refer to, but also a particular reading of the text. The practical problem for the participants is how to use the manual’s text and images to make sense of, and instruct, the embodied action Carola is engaged in. The relation between these two very distinct realms is a practical interactional accomplishment, as shown in the next fragments.

The use of the manual occasions new challenges for the participants. The alignment between the reading of the manual as instructions and the adoption of embodied measuring practices are a practical accomplishment. The manual does not directly and explicitly respond to the locally emerged problem—how to measure the femurs—in so many words. Rather the practices of mobilizing, searching through, and consulting the manual, progressively assemble the relevant manual’s instructions and align them with the actual situated practices of arranging the bones on the osteometric table.

We join the continuation of the action as the participants turn to the manual:

#### *Extract 3 (lines 24–47)*

24                   (10.5) £+ (0.5) \* (0.4)  
           tan                   ->+stops  
           car                   £moves twd ALI->  
           ali                   ->\*stops on p.112-->



- 30 (0.4)  
 31 ALI e •não eh: e não• o: anatômico.  
*and it's not eh not the anatomical*  
 •lateral gest•  
 32 (1) \* (1.3)  
 ali ->\*p.111->  
 33 CAR então eu ã não apoio?£  
*so I don't press*  
 £shakes head£  
 34 (1.7)£  
 car £goes back to the measuring table->  
 35 ALI é o comprimento máximo que- (0.3) [(apóia os dois, né?)]  
*it's the maximal length that- (0.3) [press both, right)]*  
 36 CAR [porque£ o má:]ximo  
*[because the maximal*  
 £changes posit->  
 37 de:[le,]  
*of it*  
 38 ALI [ah] não. é o que não a[póia ]  
*[ah no. it's the one that does not press/touches*  
 39 CAR [é isso£] aqui#  
*[it's this here*  
 ->£ #fig.13  
 40 ó, é o que não apoia.=  
*look it's the one that does not touch*
- 
- 13
- 
- 14
- maximal method anatomical method
- 41 TAN =é:: o anatômico (0.2) é o que apoia o  
*right the anatomical (0.2) is the one that presses the*  
 42 côndilo aí ele [fica inclina:do.  
*condyle there it remains inclined*  
 43 CAR [o £ana]tômico é o que apoia# ó:=  
*[the anatomical is the one that presses see*  
 £puts f in a oblique position->  
 fig fig.14#  
 44 ALI =porque o que a gente usa é o Troter e Glesser né?£  
*cause what we use is the Troter and Glesser right*  
 (method mentioned in the manual)  
 car ->£  
 45 (0.2)  
 46 TAN é:=  
*yes*  
 47 CAR =aham.  
*ahm*

While both Tanja and Alice flip through the manual, Carola moves towards them: all focus on the manual as the normative-epistemic source for answering her initial question. The material realm in which a solution is searched for shifts, from the measuring instrument in Carola's



hands to the manual in Tanja's and Alice's hands. At the end of the manual's consultation, Carola then walks back to her position.

Tanja and Alice stop flipping through the manual as they encounter the searched-for pages. Tanja stops at page 110, which is the first page introducing the methods of measurement for calculating the stature. By contrast, Alice stops on page 112, which begins with 4 photos picturing different measuring instruments and practices (Image 3). So, both adopt different ways of using the manual: the former consists of consulting the chapter about stature from its beginning, the latter in looking at a picture where the position of the bones on the osteometric tool is visible. While the former deals with the global alternative between two measuring techniques, the latter addresses the particular issue of whether the bones have to 'touch' the fixed extremity of the table or not, being both pressed towards it or not (see the recurrently used verb *apoiar*/‘press’, ‘touch’).

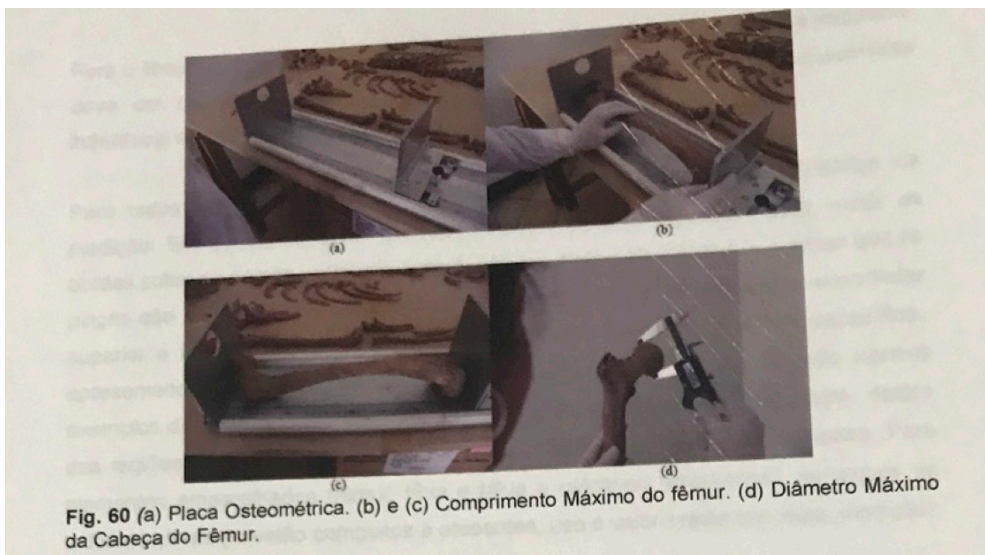


Image 3: Page 112 of the manual

On the basis of her looking (figs.10–11) at fig.60b or 60c page 112, Alice describes the position of the bone as *aqui é os dois apoiados*: (25). This description uses the same verb used by Carola in her initial question (line 6). It is prefaced by a deictic, which refers to the figures she is looking at. Carola aligns while requesting a confirmation: she is still at some distance, from which she cannot see the details of the image looked at by Alice; thus, she responds to Alice's turn (25) rather than to her deictic reference to *aqui*. Her response fully formulates again the position (*com os trocanteres apoiados na: tábuá né?* 27) while doing a gesture (fig.11) in which the right hand figures the part of the bone leaning towards the fixed part of the osteometric table. In this way, Carola achieves the alignment between Alice's reading of the manual's image and her suggested instructed embodied manipulation of the measuring instrument. However, the practical and sequential accomplishment of the match between them is still produced in a tentative way, as the final particle requesting a confirmation shows (*né?*/'isn't it'). Alice's positive response (*é!'*(it) is' 29) is produced with some delay (28). Moreover, it is followed by



another, stated as equivalent formulation (*que é* ‘which is’) of the method (*o comprimento máximo do fêmur*. 29), produced while reading the caption of the figure on the manual. So, Alice sees that both condyles touch on the image (which would refer to the anatomical method) while she reads the caption referring to the maximal method. Alice’s turn is responded to, in real time, by both Tanja and Carola (fig. 12): Tanja looks at her on the confirmation particle, and then looks back at the manual, continuing her search; Carola moves a few steps away, towards her working position, while adjusting her glove, projecting resuming work, but then comes back towards them. Thus, both orient to Alice as doing something that does not solve the problem.

Alice’s next turn (31) is a logical consequence of her previous turn: if the method is the *comprimento máximo*, this excludes the *anatômico* (she also does a negative gesture). This does not solve the issue: Carola requests another confirmation, formulating the description of the method (the *máximo* is defined as negating the contact of both condyles to the extremity of the table). Her response is in line with her coming back when hearing the name of the technique (and is followed by her moving away again). In the next turns, both Carola (36–37, 39–40) and Tanja (41) explicitly establish the relation between the method and the bone’s position—making Alice realize her error (see her *ah* particle, 39). What these turns establish is the double correspondence between anatomical = *apoiar* and maximal = *não apoiar* (36–47), as well as the fact that the method to be adopted is the latter.

Carola goes back to the measuring instrument and does an embodied demonstration of the two methods, putting the femur first in the maximal position (36) and then in the anatomic one (43), in a way that is coordinated with her formulation of the instructed position of the former (*o que não apóia* 39–40) and then the latter (*o que apóia* 41, 43). In this way, she demonstrably accomplishes the correspondence between the verbal denomination and description of the methods and their embodied implementation. Alice further provides for a confirmation, referring to the authors of the maximal method (44), confirmed by her co-participants (46, 47)—displaying her alignment with her colleagues.

Whereas Carola’s trouble is generated by her not remembering which technique is routinely used in the team, Alice’s trouble is generated by the manual and the mismatch between her reading of the images and their caption (notice that the manual does not mention *how* to do the measures, and never uses the verb *apoiar*). So, the use of the manual to solve the problem proves to generate further difficulties. Once the trouble is solved, the participants continue to orient to different ecologies: Carola engages in the embodied practical implementation of the selected method, continuing her task, whereas Alice and Tanja discuss the manual and its limitations and errors.

The excerpt shows how the manual is first mobilized as a normative source for solving a problem, read and used as an authorized instruction, and then finally criticized as a text presenting some contradiction. The manual is not straightforwardly an instruction; its instructional character is progressively achieved in its situated use, by flipping through its pages, searching the usable page, skimming through the text, and looking at the figures, in a non-linear way, which selectively highlights portions of the text/image as instructionables. Moreover, the manual is made usable—is locally achieved as instruction—by making sense of it in light of what the participants progressively recall of the technique, that is, thanks of what they

already know, and display to know or to recognize. Once the manual has helped, for all practical purposes, to solve the practical problem of which method to use and what the method consists of, this does not bring the discussion to completion. The participants retrospectively orient to what has generated some puzzlement in the discussion, turning to the manual as a text to read, criticize, and revise, rather than a normative source of information to follow as an instruction. The manual as a text is examined in another way, by switching the attention from what is represented in the text/figures to the text/image as a representation.

The issue is not yet entirely settled for the participants: this is displayed by the fact that they engage in more discussions, before finally reaching an explicit agreement about the technique to be used:

*Extract 4 (lines 95–101 + [about 20 lines omitted] lines 120–129)*

95 TAN eu acho +que é± o+ máxi\$mo.  
 I think that it is the maximal  
 +little head shakes+  
 >>looks manual±looks at CAR->  
 car \$looks at TAN->

96 (2.1)

97 CAR não apóia.  
 it does not press/touch

98 (0.3)

99 TAN +não+ a\$poia.±  
 it does not press/touch  
 +Hshake+  
 ->±  
 car ->\$

100 (1.1)

101 CAR tá bom.£  
 good  
 \$turns to move back to her position->>  
 ((20 lines omitted))

120 +(1.5)  
 tan +reorients to her work->>

121 ALI aí tira o máximo£ então né?  
 there you take the maximal then right  
 car £walks back to tabua->

120 +(1.5)  
 tan +reorients to her work->>

121 ALI aí tira o máximo£ então né?  
 there you take the maximal then right  
 car £walks back to tabua->

124 \*(1.0)\* (0.8)£  
 ali \*nods-\*  
 car ->£adjusts fêmur->

125 CAR deixo ele re:to, \$apoia um dos la\$dos e a cabeça.  
 I place it right press one of the extremities and the head  
 \$looks L/condyle\$looks R/head/measure->

126 (0.7)

127 ALI \*°tá.°=  
 PRT  
 \*looks at CAR->

128 CAR =quarenta\$ e sete# e \*meio.\*\$  
 forty seven and a half  
 ->\$looks at ALI-----\$  
 ali \*nods-\*  
 fig #fig.15



15

129 (2.0) \* (1.0) £  
 ali ->\*back at work->>  
 car £takes a pen->>

Tanja, still reading the manual, confirms the use of the maximal method (95). Her turn is addressed to Carola, whom she looks at and who responds by looking at her (95). The little head shake orients to the fact that Carola was not only projecting the anatomic method as the preferred response to her initial request of confirmation, but was also repeatedly favoring that technique, which is the one she uses in another lab; the confirmed method disaligns with these preferences.

Carola responds by reformulating the maximal method in the terms that she has been using since the beginning of the episode: *não apóia* (97). This is confirmed by Tanja repeating it (99), shaking her head. Carola closes the sequence by walking back to her work position at the osteometric table, while producing a final agreement (101).

While Carola is moving back to her work, they continue to elaborate on how the technique was established (not shown, 20 lines omitted). Tanja refocuses on her own task (120), as Alice finally also confirms the method (121). Carola aligns not only with her agreeing turn (123) but also by manipulating the bone on the osteometric table. She announces that she will perform the maximal measure (123), and begins to adjust the position of the femur (124), then providing for an online commentary (Heritage and Stivers 1999) of what she is doing while doing it. In this way, she makes publicly available to her colleagues—who have returned to their individual work—the manner she is taking the measure (125), displaying her attention to both extremities of the bone, implementing aloud the distinctive detail of the contact of one of the condyles (*um dos lados* 125), and shifting then the gaze to the femur's head which is also the place where the table is closed and gives the measure. At this point Alice looks at her, also confirming the procedure (127), and Carola tells the result (128), looking at Alice who nods (128) (fig.15). The episode closes as Alice returns to her task and Carola grasps a pen to write down the result.

The repeated agreements about the method, as well as the public display of the instructed procedure as it is implemented, show that the matter is not straightforward and orient back to the troubles encountered to establish the adequate method and a common understanding of it. This also shows how the public achievement of an intersubjectively shared measurement

and measure is treated as consequential for not only Carola's task but their collective work, the adequacy of the procedure collectively established and the validity of the measure that results. In this way, the achievement of the acceptable measurability and measure is publicly completed.

#### 4.2. Re-enacting measurements: instructability and unique adequacy

The above analyses are the result of repeated detailed scrutinizing of the video record. However, merely *looking* and *seeing* certain details on the video is sometimes not enough: some described practices crucially rely on minimal embodied movements that are not always graspable *as* methodic practices but could be taken for simple contingent adjustments. The identification and recognition of these movements constitute the unique adequacy of the analyst's vision, which can be assembled in many ways—by repeatedly looking at similar practices, by doing ethnography on the field, by reading the same manual as the participants, et cetera. In our case, the embodied details of the measuring practices were learned not only through the original video recording but also in instructed sessions with one of the participants, Tanja, who redid the measures of the same objects with us, guiding one of the authors in a re-enactment (Sormani 2020) of the studied practices. These instructed moments enable access to the practice as bodily and sensorially experienced by the participants. By directly observing the bones from the perspective of a measuring participant and feeling the movements of the bone on the osteometric table, the differences between the two methods used as well as some challenges, issues, and difficulties related to their embodied implementation are revealed in an incarnated way. In what follows, we treat this re-enactment as a video-recorded event subjected to multimodal analysis.

We join Tanja and one of the researchers, Fabia (speaker of Portuguese as a second language), as the former explains and demonstrates the anatomic method for the latter:

*Extract 5 (Demo1 01.15)*

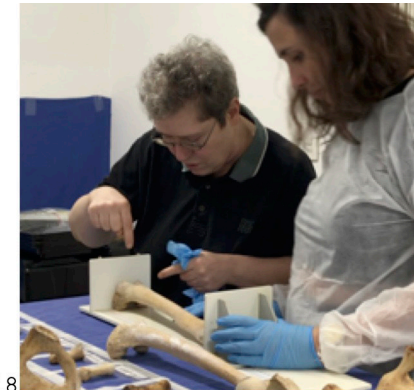
```

1      (1.5)                                * (0.4)
tan    >>puts femor on table*...->
2  TAN  ta medida anatô*mica (.) a gente vai# apoiar os
      the anatomical measure (.) one will press the
      ->*2H push cond on fixed extremity->
fab    >>looks at condyles->
fig    #fig.16
3      dois côndilos aqui:=
      two condyles here
4  FAB  =humim
      ->±looks back and forth along the table->
5      (0.3) *          (3.3)          *± (0.6)
tan    ->*readjusts slightly*LH moves to mob extrem->
fab    ±looks mob extr->
6  FAB  ah::

```



- 7 TAN e\* aí# a tábua (0.9)±(2.6) idesce até ela encostar\*#  
 And there the table (2.7) moves until it touches  
 ->\*closes the mobile part-----\*  
 fab ±moves to TAN's R±looks from ext->>  
 fig #fig.17 fig.18#
- 8 (0.6)
- 9 FAB humm
- 10 (1.8)
- 11 FAB mas+ é importante +que os dois# fiquem (0.9)+ apoiem?  
 but it is important that the two stay (0.9) touch  
 +points RH-----+points Rh and LH-----+  
 fig #fig.19
- 12 TAN é. (.) essa é anatômica  
 yes (.) this is the anatomical
- 13 (0.5)
- 14 FAB é  
 yes



Having put the femur on the osteometric table, Tanja pushes with both hands the bone towards the fixed extremity (fig.16). She formulates and embodies the main condition of the anatomic method, which is the contact of both condyles to the fixed extremity. The way she puts her hands on the bone, together with the verbal description of the condition, builds the instructionable accountability of the method she is using. Fabia's gaze back and forth, looking at the mobile extremity as Tanja is about to push it (fig.17), and changing her position around



the table (fig.18), as well as her responses (4, 6, 9) display her understanding of the ongoing procedure. She also finally rephrases the main condition (11) concerning the position of the two condyles, which is also pointed at by the indexes of both of her hands (fig.19).

Later on, the maximal method is introduced, by both participants, 1–2, and builds contrastively on the previous:

*Extract 6 (Demo1\_02.35)*

- 1 **FAB** e agora o ~~tm~~[áximo,]  
and now the maximal  
±looks back and forth along the table->
- 2 **TAN** [e aí:\* o má]ximo, a gente tem que ir mexendo  
[and there the maximal one has to keep moving  
\*RH moves bone->
- 3 **ele até chegar na altura máxima de[le# (0.7) né?\***  
it until reaching its maximal length (0.7) right  
->\*
- fab ->±looks mob extr->>  
fig #fig.20
- 4 **FAB** [è.  
[yes



20

Tanja holds the bone with the right hand and the mobile extremity of the table with the left hand (fig.20). She continuously moves the bone across the table while formulating this condition (‘we have to keep moving it until it reaches its maximum height’ 2–3). Here the technique does not rely on a specific position of the bone, but on the movements searching for its best placement producing a maximal length. Here too, Fabia’s gaze, on the movements of the bone, and finally on the mobile extremity where the results can be read, projecting that the bone is now in a good position, display her following the demonstration.

The demonstration occasions not only Fabia’s understanding, but also a series of comments and requests of confirmation which explore the indexicality of measuring. In the next long excerpt Tanja constantly delicately moves the bone on the osteometric table, demonstrating her way of operationalizing the two methods. The movements enable Fabia to formulate possible ways of implementing it and to discover some challenges and difficulties.



## Extract 7a (Demo1\_02.57, 1-19)

- 1 FAB mas eu achava que a: que o método anatômico foi  
but I thought that uh that the anatomical method was
- 2 mais difícil, mas o método máximo também apresenta su:  
more difficult but the maximal method too presents its
- 3 dificuldade não?  
difficulties doesn't it
- 4 (1.0)
- 5 TAN o máximo é mais difícil=  
the maximal is more difficult
- 6 FAB é::  
(it) is
- 7 TAN porque: ele não tem uma posição(1.0) correta (.) você tem  
because it does have a correct position (.) you have
- 8 que a[char] o máximo  
to find the maximal
- 9 FAB [é:: ]  
[yes]
- 10 (0.5)
- 11 FAB você +tem que: \*que provar (0.4)+ [eh::]  
you have to try (0.4) [eh]  
+iconic gest of adjusting bones+  
tan \*adjusts bone re anatomic position->
- 12 TAN [vo]cê vai encaixar  
[you will slot in
- 13 normal\*mente (.) o que eu \*faço? eu encaixo o ana\*tômico  
normally (.) what I do I slot in the anatomical  
->\* \*adjusts as in anat.pos\*
- 14 (0.7)
- 15 TAN \*e aí eu começo a (0.7) mexer ele=  
and there I begin to (0.7) move it  
\*moves femur->
- 16 FAB =é:  
yes
- 17 TAN pra ver qual vai ser o máximo que ele chega  
to see what will be the maximal (length) that is reaches
- 18 FAB ha:mm
- 19 (1.0)
- 20 FAB ha:mm

Fabia's comment about her realization that the maximal method might be more difficult than the anatomical (1-2) is confirmed by Tanja (5), who also gives an account for that (7-8): the latter depends on a pre-established position of the condyles, whereas the former depends on moving the bone in the search for the position that will give its maximal length. Tanja's verb (*achar*/‘to find, to experiment’, 8) is reformulated by Fabia (*provar*/‘to try’), accompanied by an oscillating gesture that magnifies the small movements on the table. During Fabia's verbal and gestural re-formulation, Tanja begins to reposition the femur on the table, proceeding again to its measure: she first positions the bone according to the anatomical method (11) while formulating what she usually does (moving from the 2d person [7-12] to the 1st person

[13–17]), then moves it in search of the best position for the maximal method (15). The latter movements last for almost one minute, during which she describes again the practice (15–17).

This occasions Fabia's comments about possible options for doing it:

*Extract 7b (cont)*

21 # (8.4)  
fig #fig.21

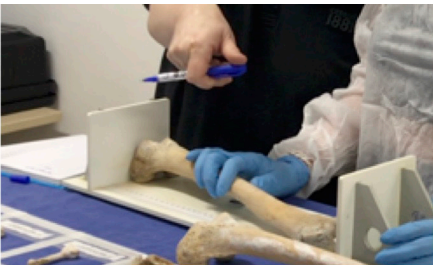


22 FAB +te depois você não vê nada# porque o::+  
and then you don't see anything because the  
+points to table's side/the ruler-----+,,,  
fig #fig.2

23 (8.0)

24 FAB ah e pode +ser nessa di#reção mas+ pode também ser ne#ssa?  
ah and it can be in this direction but also in that one  
+torques hand twd ext side+shows int side w pen->  
fig #fig.23 fig.24#

25 (1.4)  
26 TAN °aham°+  
fab ->+



27 (2.6)  
28 FAB então +poderia apoiar sobre es+te pero também poderia  
so it could touch on this but could also  
+points w pen to condyle 1+to condyle 2->

29 apoiar também sobre esse?  
touch on that one

27 (2.6)  
28 FAB então +poderia apoiar sobre es+te pero também poderia  
so it could touch on this but could also  
+points w pen to condyle 1+to condyle 2->

29 apoiar também sobre esse?  
touch on that one

- 30 TAN aham \*é. +  
->\*positions bone w condyle 2 on the extremity->  
fab ->+
- 31 FAB é.  
(it) is
- 32 TAN que às vezes eu vou vir para cá e ele vai tá maior  
which sometimes I'll move here and it will be bigger
- 33 FAB é \*é [é]  
(it) is (it) is (it) is
- 34 TAN [tá] maior  
[be bigger  
->\*positions again condyle1 on the extrem and moves it->>
- 35 (1.2)
- 36 FAB então a gente tem que- que provar os dois?  
So one has to- to try both of them
- 37 TAN aham
- 38 (10.8) \*  
->\*
- 39 TAN quarenta e dois ponto quatro  
forty two point four

Looking carefully at what Tanja is doing (fig.21), and seeing that the position of the femur covers the ruler on the side of the table, Fabia points at it (fig.22) and comments about the fact that this hinders the readability of the measure. Tanja does not respond, continuing to move the bone searching for the best position (23). This occasions another comment, about the possibility of moving the bone in one direction or another (24), both indicated with gestures (figs.22–24). This comment is *ah*-prefaced, with a change-of-state (Heritage 1984) showing that this is a sudden noticing occasioned by Tanja's ongoing movements. It is also *e/'and'*-prefaced (Heritage and Sorjonen 1994), orienting to the emerging series of observations occasioned by the ongoing manipulation. A further observation is made and pointed at immediately after (28–29), confirmed by Tanja (30), about the fact that the maximal length can be searched by pushing both condyles on the extremity of the table. This multiplies the searching possibilities, based either on one or on the other condyle—and indeed Tanja changes position from one to the other (30—as formulated later by Fabia, 36). In this way, the ongoing demonstration does not only generate observations, but also responses to these observations, exploring further possibilities that they open up. The manipulation finally ends with the announcement of a measure (39).

Tanja's instructions are further completed by Fabia proceeding herself to the measurement of the femurs, adopting successively the two methods:

*Extract 8a (Demo1\_05.55, 1–9)*

- 1 FAB então (1.4) eh:: (.) esquerdo  
So (1.4) eh (.) left
- 2 +(3.4) + (0.3)  
fab +puts the bone on the table+adjusts condyle's position->
- 3 FAB método anatômico  
Anatomical method
- 4 (4.2)

5 **FAB** os dois: apoiam#  
 The two touch  
 fig #fig.25  
 6 (1.4)  
 7 **FAB** é?+ Ωxxx°  
 Uh xxxx  
 ->+LH closes mobile extr->  
 8 (1.5)  
 9 **FAB** eu cierro# a tábua:+  
 I close the table  
 ->+looks result->>  
 fig #fig.26



25

26

The practice of the anatomic method is relatively straightforward: Fabia announces the method used (3), checks the position of both condyles (2–7) (fig.25), formulating the relevant condition (5), and closes the mobile part of the table, formulating it at the same time (7–9) (fig.26). By contrast, the practice of the maximal method encounters more difficulties:

*Extract 8b (cont. after 10 lines)*

19 **FAB** agora o máximo que é:  
 now the maximal which is  
 20 +(9.8)  
 +adjusts the bone->  
 21 **FAB** a:h  
 22 (0.8) +  
 fab ->+torques the bone various times->  
 23 **FAB** e também oh:: (7.5) a gente poderia também (0.7)+ torq-  
 and then oh (7.5) one could also (0.7) torq-  
 ->+  
 24 torquar \*(.) +torquar,+\* não?  
 torque (.) torquer couldn't it  
 +gest of torquing+  
 tan \*shakes head--\*  
 25 **TAN** não é sem\*pre- (.)\* fica na posi\*ção (1.5)\* deitado  
 no it's always (.) stays in the position (1.5) lying down  
 \*horiz hand\* \*horiz hand\*  
 26 (0.5)

- 27 **FAB** a:h +não pu- não puedo fazer isso?  
 ah I cannot- I cannot do that  
 +torques and holds the torque->
- 28 **TAN** não#  
 no  
 fig #fig.27



27

- 29 (0.7)  
 30 **FAB** isso não seria possible?  
 this would not be possible
- 31 **TAN** não +  
 no  
 fab ->+continues to adjust the bone horizontally->
- 32 (1.8)  
 33 **FAB** isso seria (0.8) então  
 that would be (0.8) then
- 34 (6.1)  
 35 **FAB** é difícil mesmo  
 it's difficult indeed
- 36 (2.8)+  
 ->+
- 37 **FAB** poderia ser esto,  
 it could be this

The method used is announced (19) and then silently Fabia adjusts the bone's position, searching for the maximal length. This proves to take time, since she experiments various positions for doing that. At some point she explores not only the horizontal plan but also the three-dimensional space, raising and torquing the bone, with one condyle still pushing on the fixed extremity of the table (22). This movement, which is repeated several times, produces an incipient formulation, suspended by an *oh* of surprise (23), then continued by a word search (*torquer*, 24—a mixture of the Portuguese verb *torcer* and the noun *torque*). This option is further topicalized by a torqued gesture (24) while Fabia interrogatively solicits Tanja, who negates this option (25). Fabia requests a confirmation (27) while doing a hyperbolic gestural version of this option (fig.27), and Tanja produces another negative answer (28); a confirmation is again requested (30) and rejected yet again (31). Consequently, Fabia continues to adjust the bone horizontally, as instructed—commenting on the difficulty of the practice (35)—until she reaches a possible measure (which is significantly expressed in the conditional mode).

While the explanation-cum-demonstration performed by Tanja raised a number of questions, observations, and noticings on the basis of the visual access to them (extract 7b), the



re-enactment in the first person of the practice generates an embodied sensorial experience of the movement on the table, including the difficulties to reach an adequate position to measure, and also the exploration of possible movements, beyond what was previously witnessed and questioned on the basis of visual access only. The re-enactment provides for the incarnated understanding of the possible adequate and inadequate movements necessary to experiment, find and achieve the relevant way of measuring.

In turn, the re-enactment provides for the possibility to witness again—based on the video record—the movements done by others, and to recognize what these movements are doing—searching for the right position, rather than just randomly or contingently adjusting, exploring one direction or another, on one condyle or another, etc. This enables the action ascription that inevitably accompanies the annotation of conducts in the multimodal transcript. The first-hand embodied experiences of the re-enactment are based on the previous first exposure to the videos of the work in situ, they retrospectively enable another perception of the phenomenal field, as well as prospectively benefit further analyses.

#### *4.3. Measures: comparing divergent results*

The first issue the participants are confronted with concerns the techniques of measuring and their embodied operationalization. The second issue concerns the production of the resulting measures, which encounters further indexical problems: rather than producing unique and convergent results, the practices occasion variable conflicting measures of the same objects. This consequently turns the measurement itself into an object of doubt, and inquiry.

After the initial discussion about the method to use, Carola continues her task alone, successively measuring 6 bones, of which 4 are isolated (presumably of different individuals) and the last 2 have been previously associated as belonging to the same individual, on the basis of previous analyses. The completion of the two last measures occasions their comparison, in the light of the presumed association of the two femurs (left and right) and the expectations created by this association (if they belong to the same individual, they cannot be hugely different). The comparison reveals some contradictions and occasions new measures, that further reveal the indexicality of measuring and of the obtained measures, as a local problem to which the participants are situatedly confronted.

##### *4.3.1. Qualitative measures: discovering a “big” difference*

We join the action as Carola publicly notices a big difference between the size of the two femurs attributed to the same individual. The fragment begins as Carola has already measured the right femur, and is now measuring the left one.



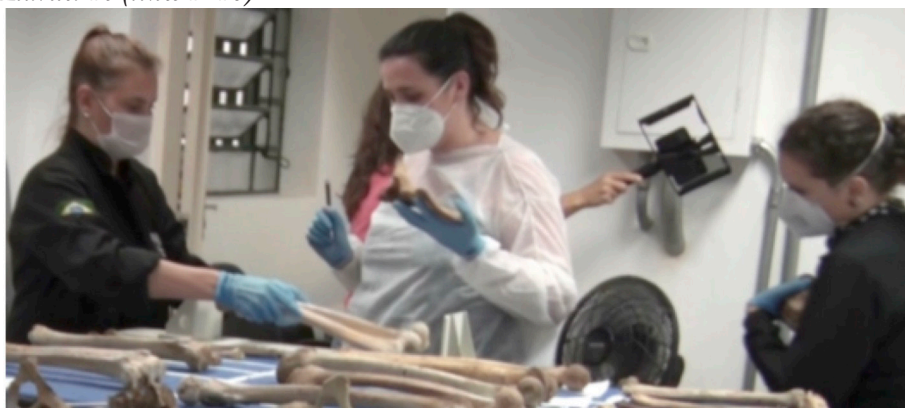


working on other tasks: ‘guys the difference of size is big [have you seen?’ (2–3). This is first responded to by Alice turning to her, then Tanja looking at her with some surprise (fig.29).

This way of appreciating the difference between the bones is qualitative and relies on holding them in parallel in the air, keeping their heads at the same level, and looking at the condyles to evaluate the difference in size. However, this appreciation depends on how the bones are held, and how they are oriented, since their extremities are not homogeneous. In this case, the visual direct comparison of the bones makes sense in the light of the results previously obtained, that indicate a significant difference: as in the documentary method of interpretation (Garfinkel 1967), having registered the previous measures shapes the vision of the size of the bones one beside the other. So, Carola *sees* a big difference between them and exhibits it for her colleagues.

However, Alice and Tanja continue their task for a while, finishing their current examination under a magnifying lamp, while Carola looks for a long time at the paper where she has written the results. As they are audibly done with their discussion, Carola takes the two femurs and walks towards the osteometric table.

*Extract 10 (lines 1–16)*



30

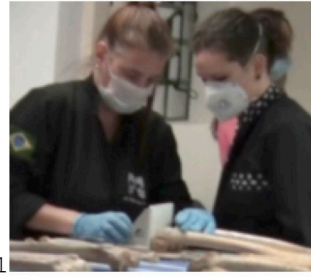
```

1      £(1.7) + (0.7)+ (0.3) * (0.2)#(0.2)
   car  £brings 2f to measuring table---->
   tan  +pivots+walks back to her seat->
   ali  *walks back->
   fig  #fig.30
2  CAR  sufpe::r
      ->£on the meas.tab.->
3      (0.4)
4  ALI  está muito diferen#te?
      is it very different
   fig  #fig.31
5      (1.4) * (0.5)#
   ali  ->*stops by CAR->
   fig  #fig.32

```



31



32

- 6 CAR °°(olha esse [tá°°]  
°°(look this [PRT°°])
- 7 ALI [(a) +[ammm]  
[(m) [mhmmmm]]]
- 8 CAR [ó:::]::  
[look]
- tan ->+
- 9 (0.3) \* (0.2) + (2.7) \*  
->\*moves away, gazing at CAR-->  
tan +looks at CAR->
- 10 ALI é aquela coisa se fosse de um [indivíduo só &  
if this would be of one [individual only]
- 11 CAR [a::i xxxx  
[there xxxx]
- 12 & a gente aceitava  
it would be acceptable
- 13 (4.3) \* (2.0)  
ali ->\*sits and looks at CAR->
- 14 CAR está muita \$coisa amiga\$  
this is a lot (my) friend  
\$looks at ALI, nodding\$
- 15 £(0.5)#(1.0)£  
car £moves smaller bone back/forth£  
fig #fig.33
- 16 CAR muita.  
a lot



33

As Alice and Tanja walk away from the lamp, returning to their seats, they can see Carola putting the two parallel bones on the table (fig.30). Carola proffers a sarcastic positive assessment (*super*, 2), which is responded to by Alice, coming closer, asking about their difference (4) and stopping, looking at the bones (fig.31–32) and at Carola manipulating the tool. This comparative measure of two bones put together, side-by-side on the table constitutes a locally

discovered, serendipitous way of comparing them, which is not foreseen by any procedure. It is occasioned by the previous comparative gesture in the air and reproduces it on the table. So, the embodied manipulation of the bones grounds the continuity of the comparative approach and the plausibility of its improvised measure. This occasions some evaluative turns (6–8), before Alice moves back to her seat. On her way, she proffers a hypothetical evaluation of the situation: *aquela coisa se fosse de um indivíduo só a gente aceitava* (10). The conditional (*se fosse* ‘if it would be’) refers to a condition that is not totally met by the current situation: the difference in size would be acceptable for the same individual (it is possible for a person to have femurs of different size). However, the conditional points to the fact that in this particular case, despite the bones having been associated together, there is not any certainty that they belong to the same individual: a big difference in size could point to the fact that the association was an error, and has to be revised. In this sense, pointing at the difference, as Carola is doing, is insinuating a doubt about the previous work which has been done, and about one of the rare associations that have been established, thereby jeopardizing several hypotheses about the number of individuals considered.

Despite Tanja and Alice walking back to their seats, where they were engaged in some other tasks, they keep looking at Carola adjusting the bones on the table. Carola responds in a delayed way to Alice’s question about how big the difference is (*está muito diferente?* 4) by using the same informal qualitative expression of quantity (*está muita coisa* 14, *muito* 16). Between these two assessments, Carola produces further evidence of the “big” difference, by moving one of the bones back and forth within the interval of the measuring table (15): this is not only visible (by her colleagues looking at her, fig. 33), but also audible, producing a metallic sound when the bone touches one extremity and then the other. The sound makes the difference even more dramatic, constituting the final *muita* (16) an upgrade of the previous *muita coisa* (14).

These assessments show that Carola refrains from giving a quantified result, probably orienting to the fact that her way of measuring is not a standard procedure, and just an estimate—although indicating in more qualitative, and even dramatic ways that results are problematic. Produced *after* Alice’s hypothetical statement (10), Carola’s responses confirm the emerging doubt that if the difference is too big, the chances that the bones belong to the same individual dissolve. In this way, her measuring work shifts again from an individual task to a collective puzzle, to be solved as a team.

#### 4.3.2. Checking measures: discovering discrepancies

Confronted with the puzzle created by seeing the divergent sizes of the two femurs, the participants engage in the next step, double-checking the previous measures. Another person

redoing a measure is a way not only to check the previous results, but to achieve their collectivization and intersubjectivity—a way to secure inter-reliability and consistency.

Double-checking emerges in a practical and embodied way, with Tanja asking about the previous results (18) and then moving towards Carola and engaging in measuring again the two femurs (19)

*Extract 11 (lines 17–47)*

- 17 (1.5)  
 18 TAN quanto que deu? (.) as medidas (0.6) de cada um?  
*how much did it give (.) the measures (0.6) of each one*  
 19 CAR quarenta e um vírgula cinco o outro quarenta e dois  
*forty-one point five and the other forty-two*  
 20 vírgula +cinco.+  
*point five*  
 tan +.....+walks twd CAR->  
 21 (1.4)  
 22 ALI pior que assim para um indivíduo atéf tolerável né  
*worst than this for an individual even tolerable right*  
 car fakes Rf outfirepositions Lf->  
 23 mas: (0.7) f(considerando as [misturas todas])  
*but (0.7) considering all the measures*  
 car ->fcloses table  
 24 CAR [ó:]  
 25 (0.6)+(6.9)  
 tan ->+positions carefully Lf on the table->  
 26 CAR quarenta e dois# vírgula três=  
*Forty-two point three*  
 fig #fig.34  
 27 TAN =ãha  
 28 CAR ah:: espera aí  
*eh wait there*



- 29 (2.8)  
 30 CAR esse é o esqu-? é: \$quarenta e +dois vírgula três.  
*this is the lef- is forty-two point three*  
 car \$nods repeatedly-----\$  
 tan ->+takes away Lfem->



```

31      £(1.5)
      car      £gives Rf to TAN->
32 CAR      e es£+se.
      and this
      car      ->£
      tan      ->+takes and positions Rfem on measuring table->
33      (2.1)
34 CAR      direito.
      right
35      (10.4)
36 TAN      quarenta e um vírgula sete
      Forty-one point seven
37      $(3.6)$ +(0.6)
      car      $looks at both extremities, nodding$
      tan      +moves bone on measuring table->
38 ALI      são cinco milímetros [de +diferença]
      these are five millimeters of difference
39 CAR      [mas faí] você está encos#tandof
      [but there you are pushing
      tan      ->+
      fig      £points at Rextrem-----£
      #fig.35A/B
40      os trocanteres
      the trocanthers

```



41 (0.5)  
42 TAN é: então.  
yes so  
43 \*(0.9)  
tan \*carefully checks/readjusts fêmur on meas.tab.->  
44 CAR [a gente não-]  
[we don't-]  
45 TAN [(agora mexeu não] tô mais tocando)  
[(now it just moved I am not touching any more)  
46 (4.4)  
47 TAN essa é a máxima mesma  
this is indeed the maximal

Tanja asks about the past results obtained by Carola when she initially measured the femurs (the use of the past tense, *deu* 'gave' 18 refers to the initial numbers and not to the comparative measuring Carola was just doing, which is not treated by them as a proper measure). Carola announces two measures, 41.5 and 42.5 (19–20), which present a difference of 1 cm. This difference is commented upon by Alice (22–23) referring again (see line 10), to the contrast between the case of an individual, in which differences might exist, and the current case, in



which, given that the bones of various individuals have been mixed up, the difference might create a doubt whether the femurs are really associated or not. Alice, thus, makes explicit what is at stake: beyond the measure itself, beyond the calculation of the stature to which the measure contributes, the difference might point to an error in the past attribution of the bones to the same individual.

During Alice's comment, Carola prepares the table for Tanja (22–23): now the measure is done together, with Tanja adjusting the femur on it (25), making the measure available for Carola, who reads 42,3 (26), confirmed by Tanja (27). The fact that one person does the measure and the other reads it aloud (fig. 34) is a way of collaboratively co-producing and sharing the result. Next, they position the right femur on the table, Tanja adjusts it (32) and she announces the other result, 41,7, while Carola looks at the measure on the table and nods (37). Again, they display an intersubjective agreement about the result. Alice says aloud the difference (38) which is considerably less than the previous one.

In the meanwhile, Tanja has slightly moved the bone on the osteometric table, and Carola points (fig. 35) to the fact that this rather corresponds to the other technique, the anatomical one. This critical comment hints at a possible reason for the divergent results. However, Tanja corrects the position of the extremity (43), rejects the description Carola made and reaffirms her measure (47).

The results are finally repeated and inscribed, closing the measuring activity:

*Extract 12 (lines 70–99)*

- 70 TAN o di+rei:to (0.4)+ é quarenta e um vírgula sete (0.5) que  
 car >>at her seat, pen in RH ready to write->  
 +touches R---+
- 71 foi esse que a gente entrou agora.  
 was the one that we are just in now
- 72 (0.8)
- 73 CAR uhm:hum: então dois: (0.3) só dois milímetros=  
 uhm hum then two (0.3) only two millimeters
- 74 TAN =o esquerdo está <quaren:ta e dois+ vírgula três>  
 the left one is <forty-two point three>
- 75 (0.7)
- 76 CAR vírgula três?=  
 point three
- 77 ALI =tá:  
 PRT
- 78 £(0.8)  
 car £writes correction on the sheet->
- 79 TAN vírgula quatro.  
 point four
- 80 (0.3)
- 81 TAN ttrês.t  
 three  
 tapprox gestt
- 82 (0.9)+  
 tan ->+
- 83 TAN tá [dentro]  
 (it) is [in (within the margin of error)]
- 84 ALI [é zero cinco:?]  
 [it's zero (point) five]
- 85 (1.1)

Tanja repeats the measure (70) for Carola, who has moved back to her initial seat and is ready to write down the final numbers: first regarding the right femur (41,7, lines 70–71), occasioning Carola's noticing of the difference of 2mm with the previous measure, which was 41,5 (73), second regarding the left femur (42,3, line 74), occasioning a last adjustment of the measure in Tanja's hands (76–81), moving both the mobile part of the measuring instrument and the bone to check the maximal extension, making a difference of 1mm public (42,3 vs 42,4). The final measure (42,3) is produced with an approximating gesture that shows the margins of variation. Thus, despite her careful manipulation of the bones, Tanja hints here too at an indexicality of the measure, depending on the slight instability of the tool's extremity.

Both measures enable Tanja to state that *tá dentro*/'(it) is within' (83) the limit of 0,5 cm of acceptable variation, confirmed by Alice (83–87). This responds to the possible consequences of a too big difference between the bones: the risks evoked just before are thus rejected. This is addressed by Carola too, with a positive concluding assessment (*beleza então*/'great then' 89), and by Alice, stating the dissolution of the problem (91).

Taking the last femur away from the measuring table, Tanja grasps the associated bone (fig. 36) and raises both of them in the air—as Carola was doing at the beginning of the discussion (fig. 37). This time, in the light of the just produced results, the comparative sight on the bones confirms their similarity, rather than their difference (as above)—showing how the documentary method of interpretation works in an opposite direction here. She puts them back on the table, beneath the tibias, and in conclusion confirms their association (*eles são juntos*/'they are together' 97), repeated by Carola (99) as Alice laughs. The final measures are not commented *per se*, but in relation to the dramatic doubt that their possible difference and discrepancies have raised, potentially jeopardizing their previous work on much more than these bones in particular.

## 5. CONCLUSION

Approaching measurements and measures in an EMCA perspective as collective, situated, material and embodied achievements, as suggested by Lynch (1991), this study has detailed the careful work needed to achieve intersubjectively acceptable measurements of bones within a team of forensic anthropologists. In this way, the study contributes to a praxeological multimodal analysis of measuring and more generally of forensic work practices.

We have highlighted first how measuring practices involve the choice of a technical procedure and its constitutive conditions, the shared understanding of the particulars of this technique, and finally their implementation, supposing a specific arrangement of the measurement tool (osteometric table), the measured object (here, the femur), the hands manipulating it, and the (sometimes collective) vision reading the measure when the object is adequately placed. However, we have also shown that participants engage in serendipitous situated locally emergent forms of measuring, or evaluating measures, beyond the prescribed techniques—which shows how measuring is also a matter of situated creative judgment (see Ivarsson and Falkenberg 2024). Second, we have demonstrated how participants can engage in different forms of measurement, producing variable results, whose variability, difference, and contradiction are addressed by them: the measure is not produced in a vacuum, but within a set of

expectancies, and within the contexture of broader connections with other features of that object and other objects, which shape the expectability, interpretability and possible consequentiality of the measure.

In both cases, the indexicality of measuring is at play: indexicality of the understanding of the method itself, of the embodied mobilization of the bone on the osteometric table, within the participants' attempts to fulfill the conditions of the method used, but also within their contingencies; indexicality of reading the measure on the metered table; indexicality of instructions about how to measure, searched, read, interpreted, criticized, but also heard and followed; indexicality of grasping and interpreting the measure, relatively to what is anatomically expected in relation to an ordinary individual, to what is supposed about the bones belonging to the same individual, to what is suspected, feared, imagined in this extraordinary case in which there is uncertainty about the individuation of the persons, and to what is known and unknown in relation to the provenience of the bones.

Beyond the indexicality of measuring and measures, the episode also reveals wider connections between measuring and situated work activities: different methodological cultures across institutions, complex conditions of work affecting part-time employment in various laboratories, and causing discontinuities in the work, occasioning "forgetting" about the procedures. Furthermore, the indexicality of measuring points at the specificity of the context of forensic work and its circumstances, at the complex mixture of bones the forensic experts are confronted with, as resulting from a troubled history in which state violence against disappeared political activists included the post-mortem dismembering, disseminating and mixing of their bones, making not only their re-identification generally difficult but also, more subtly, suspending standard inferences, expectancies and forms of reasoning about measures, and therefore the standard and reasonable interpretations of their variations, divergences, and errors. In this sense, the analysis contributes to an EMCA understanding of forensic work as both situatedly embodied in its local ecology and contextually embedded in complex historical circumstances.

The details of the situated practices studied achieve the relevancies to which the participants orient to in their work; they constitute what Garfinkel calls the "phenomenal field properties" of the things examined, defined as their "in vivo developingly phenomenal details" (2002, 99). The details of the measuring practices are publicly witnessable: they are exhibited for and can be perceived by colleagues involved in other task, but overseeing and monitoring the current work, therefore able to intervene, correct, instruct them, or join into their collective production. They are instructable, by reference to the manual used in the team, or by reference to the local guidance and expertise of a colleague. They are inspectable in case there is a trouble, an error, a contradiction.

This public accountability, witnessability, and scrutability of the measuring practices and their outcomes also concerns the co-present camerapersons and possibly the video record produced by them and watchable again and again by them, also shareable with the participants. This builds a first form of unique adequacy (Garfinkel 2002)—based not on the video data as an autonomous external exogenously constituted record, but rather on the video recording as a commonly agreed and trusted perspective on the work, implicating the co-presence of the researchers in the lab, sharing the daily work of the forensic experts and their concerns. On

this basis, the re-enactment (Sormani 2020) of the measurement, by one participant first, by one researcher then, is just a natural prolongation of the action: for the participant it was a way to check the measure again, for the researcher it is a way to be instructed in how to measure, and to engage in the first-hand experience of measuring, of feeling the slight movements of the bone on the osteometric table, of feeling and seeing the consequences of moving it in a certain way, thereby also contributing to the triple-check of the measure itself. The experience building the unique adequacy enables to understand—and even to feel—the instructable details of the work, that is, the details that constitute the work, to which participants orient to, and that enables them to do, redo and continue that work, while making sense of the phenomenal field in which it occurs and that it contributes to reproduce. The unique adequacy has radical consequences for the way of seeing and transcribing details, of attributing them to specific practices and actions (rather than to generic or contingent movements of the hand). In turn, these details are fundamental to understanding the methodicity, indexicality, normativity, intersubjectivity of the practices that achieve measuring and the measure as, in the end, an objective, mutually agreed upon result.

## TRANSCRIPTION CONVENTIONS

Talk has been transcribing according to Jefferson (2004) and embodiment according to Mondada (2018).

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