The Relationship between Movements and Positions of the Head and the Torso in Finnish Sign Language

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Abstract

This article discusses a study of the relationship between movements of the head and the torso in Finnish Sign Language (FinSL). It describes the differences and similarities in the articulation of these two body parts in FinSL narratives and discusses the status and relationship of the head and the torso as articulators in sign languages. The study reveals that, in FinSL narratives, the head is clearly more active than the torso. When both the torso and the head moved, almost half of the co-occurrences were found to be simple combinations of codirectional movements, while slightly more than half of the co-occurrences were semicomplex or complex combinations with differences in the direction of the movements. Most of the co-occurring torso and head movements shared the same function, regardless of the degree of complexity of the combination. However, differences in the functions of torso and head movements were found to increase as the complexity of the combined movements grew.

1. Introduction

Nonmanuals (i.e., movements and positions of the torso, head, and upper and lower face) are considered to be an integral part of sign languages. In order to form a theory of nonmanuals and the role of nonmanuality in a sign language, one must investigate the forms and functions of articulations of the torso, the head, and the face separately, as well as in relation to each other and to the articulation of the hands. Research on various sign languages has provided much information on facial articulation (see, e.g., Wilbur and Patschke 1999; Boyes-Braem and Sutton-Spence 2001). For example, studies have been done on the articulation of the lower and upper face (e.g., mouth actions, eye aperture, eye-brow position) in relation to lexical signs or the informational structure of utterances in several sign languages (ibid.). However, studies that focus specifically on the forms and functions of torso and head movements are not so common (see, e.g., Liddell 1986; Schalber 2006; Lackner 2013). Movements of the head have been observed in negations, affirmations, and interrogatives (e.g., Zeshan 2006; Wilbur 2000; Lackner 2013; Puupponen et al. 2015) and in the marking of prosodic units or their boundaries (e.g. Wilbur 2000; Sandler 2012). Body movements have been found to play a part in
constructed action (CA), to contribute to the meaningful use of space in signed discourse, and to coincide with different discourse-level units (Engberg-Pedersen 1993; Wilbur and Patschke 1998; Boyes-Braem 1999; Crasborn and van der Kooij 2013; Hodge and Ferrara 2013).

In FinSL, research on nonmanuality has investigated mouthing and mouth gestures (Pimiä 1987; Rainò 2001; Rauhansalo 2015). Observations of head movements and facial articulation in interrogatives and negatives have been noted (Savolainen 2006), while more recent phonetic research has concentrated on the forms and functions of head movements (Puupponen 2012; Puupponen et al. 2015). As in the linguistics literature on other sign languages, studies of torso movements and positions in FinSL are far fewer in number, apart from individual references to body movements in constructed action (Rissanen 1992; Luckasczyk 2008; Jantunen 2017), syntactic boundaries in equative sentences (Jantunen 2007), and coordination (Jantunen 2016). Consequently, the relationship between the torso and the head in the articulation of FinSL also remains unexplored. An exception is Jantunen et al. (2012), who found that, according to motion-capture location data on continuous signing, the correlation between movements of the torso and the head is very strong.

Our knowledge of the relationship between the articulations of the torso and the head is still quite limited. Movements of the head and the torso have been addressed in sign language literature in various ways. Some studies have dealt with the actions of the torso and the head as a single unit, whereas others have emphasized the independence of different nonmanual channels. Wilbur and Patschke (1998) discuss contrastive stress in American Sign Language (ASL) and, when referring to a body lean, take into account the various movements “of the body, shoulders or head” (ibid., 279). In addition, a study of contrastive focus structures in the Sign Language of the Netherlands finds that movements of the body vary according to whether they are produced with only the head or with the head and the torso together (Crasborn and van der Kooij 2013, following Wilbur and Patschke 1998 and van der Kooij, Crasborn, and Emmerik 2006).

On the other hand, when addressing the simultaneous layering of nonmanuals in ASL, Wilbur (2000) underlines the independence of different nonmanual channels, such as head position, body position, and the activities of different parts of the face. In this context Wilbur implies that one nonmanual marker may be produced with different nonmanual articulators. However, it remains unclear whether a single nonmanual element tends to be a combination of the activities of several nonmanual articulators (such as the torso and the head) or whether these separate channels alone are commonly used to produce individual nonmanual elements.
Discussing the criteria for identifying CA in sign language discourse, Cormier, Smith, and Sevcikova (2015) recommend the use of several articulation tiers when annotating data. In this approach, the articulations of a signer’s head and torso (as well as face, eye-gaze, dominant hand, and nondominant hand) are annotated in separate tiers, as they represent different characteristics of a referent. Cormier and colleagues conclude that the multitier annotation of CA sequences makes it possible to identify different levels of constructed action on the basis of the active articulators and the degree of activation (see p. 9). This method shows that annotating and analyzing torso and head movements separately may be necessary in order to understand the roles they play (together or separately) in linguistic strategies emerging in signed discourse.

The aforementioned references demonstrate that the torso and the head may be seen either as independent channels of articulation or as two closely connected sources of movement. By implication, torso and head movements can occur together to perform a shared function; only head movements may be used; or torso and head movements may overlap and have independent functions. However, it is unclear when, how, and why the torso and the head move together or the head moves independently of the torso, and whether torso and head movements usually perform the same function. In order to understand the significance of nonmanuals in the structure of a sign language and the connections between prosodic, phonological, syntactic, and discourse elements, it is important to comprehend the relationship between the different parts of the body involved in signing. This entails an evaluation of the relationship between the activity of the torso and the head in the articulation of sign languages.

This article presents a study of the relationship between the movements and positions produced with the head and the torso using narrative data from FinSL. The goal of the study is to investigate (a) whether the signer’s head moves primarily together with the torso, on its own without the torso, or with the torso but independently of it; and (b) whether co-occurring torso and head movements perform the same function. The objective is to determine the extent to which the actions of these two body parts should be viewed separately. In order to answer these questions, the movements and positions of the head and the torso were annotated and analyzed according to their activity, timing, direction, and function in data consisting of twelve FinSL narratives.

With regard to activity, the degree of activeness of the two body parts was investigated on the basis of the number of annotation cells given for different types of torso and head movements in the data. With relation to timing and direction, the focus was to examine how torso and head movements overlap. The co-occurrences of torso and head movements were
annotated and analyzed in different phases with the help of automatic and manual annotation. The directions of co-occurring torso and head movements were then viewed, and the co-occurring movement combinations were categorized according to their degree of complexity. As a result, the co-occurrences of torso and head movements were defined as simple, semicomplex, or complex combinations, depending on the number of co-occurring codirectional and directionally differing movements. Finally, the functions of torso and head movements in simple, semicomplex, and complex combinations were analyzed in order to learn whether the movements performed a shared or an independent function while co-occurring.

The remainder of this article is organized as follows: I first present observations previously made on head and body movements and their functions in research on FinSL and other sign languages. I then outline the goals and research questions, the data, and the method of the current study. After that, I present an analysis and the results of the study and follow these with a discussion and a conclusion.

2. Background: Head and Body Movements in Sign Languages

2.1 Forms of Head and Torso Movements in the Sign Language Literature

The sign language literature has mentioned a variety of head movements used in grammatical and/or prosodic contexts. These are single head nod, repeated nodding, headshake, sideways head tilt, sideways head turn, forward head thrust, and a backward movement of the head (also called a head pull) (e.g., Liddell 1980, 1986; Wilbur 2000; Zeshan 2006; Pfau and Quer 2010; Puupponen et al. 2015). In addition, movements referred to as chin-up (also called raised chin or backward head tilt) and chin-down occur in sign language research as well, especially in questions and conditionals (e.g., Zeshan 2006; Schalber 2006; Pfau and Quer 2010). However, studies do not always explicate whether the movement of the chin is accompanied by a movement of the whole head forward or backward or with neither of the two.

With regard to the movements of the torso, body leans have been observed in prosodic units and discourse strategies (e.g., Wilbur and Patschke 1998; van der Kooij, Crasborn, and Emmerik 2006; Hodge and Ferrara 2013). In addition, movements of the torso are mentioned in the corpus annotation guidelines of Swedish Sign Language (Wallin and Mesch 2014). These torso movements—lean forward, lean backward, lean right, lean left, turn right, turn left, shoulders up, and shoulders shrugged—form the basis of the annotation work on torso movements in the current study.
The aforementioned types of torso and head movements are psychological concepts of the motion of the body, the anatomical characteristics of which are not specified. For example, sideways tilts of the head are often referred to merely as head tilts, without explicating the direction of the movements. According to the anatomical features of the head and the torso, movements of these two body parts emerge as rotations in the horizontal plane, flexions in the sagittal plane, or flexions in the frontal plane (figures 1 and 2). In addition, forward and backward movements of the head may emerge as protractions and retractions in the sagittal plane (figure 1).

![Figure 1. Anatomy of head movements according to the cardinal planes.](image)

![Figure 2. Anatomy of torso movements according to the cardinal planes.](image)
Although the overall movement trajectories of the head and the torso seem similar in figures 1 and 2, the muscles and joints producing the movements differ. Movements of the torso and movements of the head both involve the vertebral column. However, movements of the torso activate the thoracic and lumbar vertebrae, whereas movements of the head activate the cervical vertebrae (DeStefano 2011). Moreover, due to the vertebral anatomy and spine kinematics, spinal movements often include a coupling of rotation and side bending of the torso, which is controlled by different physiological mechanics (ibid.). Nevertheless, one of the objectives of the current study is to investigate how often the torso and the head move together in a similar way. Because an in-depth discussion of human anatomy and motion are beyond the scope of this article, the movement types found in the sign language literature (and listed on pp. 5–6) were first viewed against the anatomical features of the motions presented in figures 1 and 2 (see table 1) and were then simplified into categories based on the direction of the motion. As described here, this process of simplification facilitated the annotation and analysis of the timing and direction of co-occurring torso and head movements.

Table 1. Types of Head and Torso Movements in the SL Literature according to the Anatomical Terms of Movement

<table>
<thead>
<tr>
<th>Anatomy of Movements</th>
<th>Types of Head Movements</th>
<th>Types of Torso Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>rotation</td>
<td>turn right, turn left, headshake</td>
<td>turn right, turn left</td>
</tr>
<tr>
<td>flexion/extension</td>
<td>nod, nodding, chin-up, chin-down</td>
<td>lean forward, lean backward</td>
</tr>
<tr>
<td>lateral flexion</td>
<td>tilt right, tilt left</td>
<td>lean right, lean left</td>
</tr>
<tr>
<td>protraction/retraction</td>
<td>thrust, pull</td>
<td>—</td>
</tr>
<tr>
<td>elevation/depression</td>
<td>—</td>
<td>shoulders up, shoulders shrugged</td>
</tr>
</tbody>
</table>

In order to study the frequency of formally similar and co-occurring torso and head movements, the anatomical categorization of torso and head movements (see table 1) was simplified in the following ways. First, upward movements of the shoulders and shoulders shrugged were excluded from the investigation of codirectional torso and head movements due to the absence of parallel head movements. In addition, repetitive head movements (e.g., headshakes, nodding)
were excluded from the investigation of codirectional torso and head movements but included in the analysis of more complex combinations of co-occurring torso and head movements (pp. 11–13). Second, movements involving rotation (e.g., sideways turns of the torso or head) were combined with sideways leans/tilts and were examined as movements to the right or left. Finally, chin-up and chin-down movements, head thrusts, and head pulls were examined as movements forward and backward, and the co-occurrence of head nods with torso movements was examined separately. This process resulted in four directional categories of head and torso movements: right, left, forward, and backward. These directional groups (see table 2) for both head and torso movements served as a starting point for the annotation and analysis of co-occurring codirectional torso and head movements (see pp. 11–13).

Table 2. Torso and Head Movements: Right, Left, Forward, Backward

<table>
<thead>
<tr>
<th>Direction</th>
<th>Types of Head Movements</th>
<th>Types of Torso Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>right</td>
<td>turn right, tilt right</td>
<td>turn right, lean right</td>
</tr>
<tr>
<td>left</td>
<td>turn left, tilt left</td>
<td>turn left, lean left</td>
</tr>
<tr>
<td>forward</td>
<td>chin-down, thrust</td>
<td>lean forward</td>
</tr>
<tr>
<td>backward</td>
<td>chin-up, pull</td>
<td>lean backward</td>
</tr>
</tbody>
</table>

2.2 Functions of Head and Torso Movements in Sign Languages

In the sign language literature, head movements have been associated with various grammatical, prosodic, gestural, and/or discourse-level functions. For example, head movements (e.g., single nods, nodding, headshakes, head thrusts) have been found to differentiate between affirmative, negative, and interrogative sentence functions (e.g., Wilbur 2000; Zeshan 2006; Lackner 2013; Puupponen et al. 2015). In addition, forward- and backward-directed head movements or head nods have been found to align with the boundaries of prosodic, syntactic, and/or discourse sequences (Sandler et al. 2011; Wilbur 2000; Puupponen et al. 2016) and to increase the prominence of single signs (Wilbur 2000; Puupponen et al. 2015). Sideways head tilts, on the other hand, are believed to bind together manually signed sequences (e.g., Sandler et al. 2011; Puupponen 2012; Jantunen et al. 2016a).
Furthermore, combinations of torso and head movements have been found to perform different prosodic and/or discourse functions. Forward-backward and right-left movements of the body have been found to encode information structure and they have been associated with contrastive stress. These same movements may also be used to express meanings of exclusion and inclusion. (Wilbur and Patschke 1998; van der Kooij, Crasborn, and Emmerik 2006; Crasborn and van der Kooij 2013.) Sideways torso and head movements have also been found to mark the junctures of coordinated elements in discourse (Jantunen 2016). In addition, as mentioned on pp. 2–3, various movements of the torso and/or head have been shown to contribute to constructed action, a strategy in which signers depict referents in discourse with nonmanual and manual activity (e.g., Hodge and Ferrara 2013; Cormier, Smith, and Sevcikova 2015). According to Cormier, Smith, and Sevcikova (2015), diverse types of constructed action are overt, reduced, or subtle, depending on the number of active articulators, such as eye-gaze, torso, and head, as well as the degree to which they are employed. Constructed action constitutes reference tracking in discourse but it is yet unclear how and into what extent torso and head movements are used for reference tracking when signers are not enacting actions of a referent (see Schembri, Fenlon, and Cormier 2016). However, some observations have been made of the existence of such movements in, for example, FinSL and Austrian Sign Language (Puupponen 2012; Lackner 2013).

3. A Study of the Movements of the Head and Torso in FinSL

3.1 Goals and Research Questions

The goal of the current study was to examine the relationship between the activity of the torso and that of the head in FinSL narratives. The research aimed to find answers to two questions: Does the head tend to move together with the torso, independently of the torso, or together with—but in a manner that differed from that of—the torso? Do co-occurring torso and head movements perform one and the same function or independent functions? On the basis of the analysis, the study also aimed to discuss whether the torso and the head should be considered as one or two articulators in FinSL.

In order to answer these questions, the movements of the torso and the head were analyzed using data consisting of twelve signed narratives. For Question 1, the study focused on comparing the overall activity (i.e., number of movement events) of the torso and the head, as well as the timing (i.e., co-occurrence) and the direction of torso and head movements in the
The investigation of the activity was carried out on the whole data set, whereas the timing according to the direction of movements was analyzed using six narratives (half of the dataset). For Question 2, the functions of co-occurring torso and head movements were annotated and analyzed from a subset of four narratives.

3.2 Data

In the collected data, twelve native FinSL signers (eight females and four males) between the ages of 20 and 60 retold the stories in the picture books Snowman and Frog, Where Are You? The overall duration of the material is 45 minutes 12 seconds. The data were collected in 2013 as a part of the collection of a larger corpus of the sign languages of Finland¹ at the Sign Language Centre of the University of Jyväskylä. During the collection of data, the signed stories were among the six or seven communicational assignments given to the signers, who worked in pairs in a dialogue setting (see figure 3a).

The signing of the participants was filmed in a studio by seven HD video cameras, which recorded the participants from different angles (see figure 3b). The setup included one ceiling camera that recorded the participants from above in order to add depth to the motion of each signer’s torso, head, and hands. The data-recording process is described in more detail in Puupponen et al. (2014) and Salonen et al. (2016).

Figure 3. (a) Dialogue setting in the studio; (b) camera setup in the recordings (Puupponen et al. 2014; Salonen et al. 2016.).

¹ www.jyu.fi/hum/laitokset/kielet/oppiaineet_kls/viittomakieli/tutkimus/finslscorpusproject
3.3 Basic Annotation of Torso and Head Movements

The narrative data were processed in the ongoing ProGram project\(^2\) at the University of Jyväskylä. Annotations have been created in ELAN for manual signs and sentences (meaning-based annotations), syntactic structure, head movements, and torso movements (see Jantunen et al. 2016b). The basic annotation of head movements was done in twelve tiers, and that of torso movements in nine tiers in ELAN (see table 3).

Table 3. Schema for Tiers Used in the Annotation of Head and Torso Movements in ELAN

<table>
<thead>
<tr>
<th>Head-Movement Tiers</th>
<th>Torso-Movement Tiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>head nod</td>
<td>body lean F(oward)</td>
</tr>
<tr>
<td>head nodding</td>
<td>body lean B(ackward)</td>
</tr>
<tr>
<td>head thrust</td>
<td>body lean R(ight)</td>
</tr>
<tr>
<td>head pull</td>
<td>body lean L(eft)</td>
</tr>
<tr>
<td>head chin-up</td>
<td>body turn R(ight)</td>
</tr>
<tr>
<td>head chin-down</td>
<td>body turn L(eft)</td>
</tr>
<tr>
<td>head tilt R(ight)</td>
<td>shoulders up</td>
</tr>
<tr>
<td>head tilt L(eft)</td>
<td>shoulders shrugged</td>
</tr>
<tr>
<td>head turn R(ight)</td>
<td>body other</td>
</tr>
<tr>
<td>head turn L(eft)</td>
<td></td>
</tr>
<tr>
<td>headshake</td>
<td></td>
</tr>
<tr>
<td>head other</td>
<td></td>
</tr>
</tbody>
</table>

As table 3 shows, all of the annotation cells include the type of movement (e.g., *head tilt L*), as well as an ordinal number that indicates the time at which the movement occurred in the discourse (e.g., *head tilt L 01, head tilt L 02*). The groups *other head movements* and *other torso movements* include movements that are not found in the sign language literature and are

\(^2\) users.jyu.fi/~tojantun/ProGram
infrequent and peripheral in the data (e.g., moving the whole head up or down; upward movements of the torso, during which the signer straightens his or her spine).

In the annotation, movements of the torso or the head include continuously dynamic movements in which the head or the whole upper body moves from place A to place B and then back to A. This whole sequence was annotated as a single cell. In addition, single events refer to movements that include a static position, in which the torso or the head moves from place A to place B, remains at place B, and then moves back to place A. These movement-hold-movement sequences were also annotated as a single cell, which was relatively long in duration. If the torso/head movement was immediately followed by a subsequent movement, the end of the annotation cell was placed approximately in the middle of the transition between the two movements.

3.4 Annotating and Analyzing the Relationship of Torso and Head Movements: Activity, Direction, Timing, and Function

In the analysis of torso and head movements, the degree of activeness of the head and the torso was studied in the overall number of annotation cells given for different types of torso and head movements in the basic annotation phase. First, the number of annotation cells for different types of head and torso movements was calculated from all twelve narratives in the data and collected in tables in Excel for further examination. The results of the analysis are presented on pages 188–191 and they include the number and distribution of the different types of torso and head movements and an overview of the variation in the number of torso and head movements between individual narrators.

With regard to the timing and direction of torso and head movements, the study focused on analyzing the co-occurrence of torso and head movements directed forward, backward, right, or left in six narratives (see table 2). The objective was to find instances of co-occurring torso and head movements and to investigate their degree of complexity, that is, whether the movements were purely codirectional (i.e. the head and torso moving together) or whether the combinations of torso and head movements were more complex and included movements that were produced simultaneously in different directions. The work included several steps of automatic and manual annotation and analysis of each of the six narratives in ELAN.

First, by using the Merge Tier operation in ELAN, tiers for sideways leans and turns of the torso and for sideways tilts and turns of the head were merged according to the direction of the movement. This resulted in eight tiers: four merged tiers for the head movements and four
for the torso movements (head/torso forward, backward, right, left). Second, from the merged
tiers of torso and head movements, annotations were created for the co-occurrences of torso
and head movements with the Create Annotations from Overlaps operation in ELAN. For
example, the tiers head left and torso left resulted in one tier, overlap head torso left, which
consisted of annotations of co-occurring torso and head movements directed leftward. Each
annotation cell included the individual codes for the co-occurring torso and head movements
according to the order in which they emerged in the data.

After automatically creating four annotation tiers for the co-occurrences of codirectional
torso and head movements (head and torso forward, backward, right, and left), the annotations
were examined manually. During this phase, separate annotations were manually created on
dependent tiers for all other torso and head movements produced during these co-occurrences.
In addition, misleading or incorrect annotations—due to, for example, the one-to-two-frame
overlaps between the ends and the beginnings of annotation cells in different tiers—were
deleted and excluded from the analysis. The annotations in the overlap tiers and their dependent
tiers were then exported as tab-delimited text and brought together in a table in Excel for further
examination.

In Excel, the data were tagged with color codes according to the number and
directionality of the co-occurring torso and head movements. If the co-occurring torso and head
movements were purely codirectional, the sequence was tagged as simple. If the sequence
included a codirectional movement of the torso and head, as well as one other head movement,
the sequence was tagged as semicomplex. Finally, if the sequence included codirectional torso
and head movements, as well as several other torso and/or head movements, it was tagged as
complex. The results of the analysis of the direction and timing of torso and head movements
are presented on pp. 16–18 and include examples of the simple, semicomplex, and complex
combinations of co-occurring head and torso movements, as well as the frequency of these
different combinations in the data in the forward-backward and right-left dimensions.

Finally, in order to reach any conclusions about the status of the head and the torso as
articulators operating in tandem or independently, we must examine the functions of both the
simple codirectional combinations and the more complex co-occurrences of torso and head
movements. Therefore separate annotations were created for the functions of overlapping torso
and head movements in four narratives. Each functional annotation cell included information
on whether the co-occurring torso and head movements had the same function or different
functions and what, precisely, these functions were. The results of the analysis are presented on
pp. 18–22 and include a comparison of consistency in the functions of torso and head
movements between simple and complex combinations, examples of the functions of torso and head movements in simple and complex combinations, and a short comparison of the functions of torso and head movements in the data in the forward-backward and the right-left dimensions.

4. The Overall Activity, Direction, and Timing of Torso and Head Movements

4.1 Activity and Direction

The results of the analysis of different types of head and torso movements produced in the twelve narratives show that the head was clearly more active than the torso: The average narrative consisted of 207 head movements but only 50 torso movements (table 4).

Table 4. The Number of Head and Torso Movements in the Data (Column 1) and as an Average per Narrative (Column 2)

<table>
<thead>
<tr>
<th></th>
<th>All Data (n)</th>
<th>Average per Narrative (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>head movements</td>
<td>2,482</td>
<td>207</td>
</tr>
<tr>
<td>torso movements</td>
<td>599</td>
<td>50</td>
</tr>
</tbody>
</table>

The distribution of different types of head and torso movements in the data is shown in figures 4 and 5. The most frequent head movements were head nods and sideways head turns to the right: Nods and right turns each constituted 13 percent \((n = 343)\) of all head movements in the data. The most frequent torso movements were forward leans, which made up 24 percent \((n = 144)\) of all torso movements in the data.
Figure 4. Distribution of types of head movements in the data (all twelve narratives).

Figure 5. The distribution of different types of torso movements in the data (all twelve narratives).
As figure 4 shows, the frequency of different types of head movements varied in the data. For example, sideways head turns occurred more frequently \((n = 572)\) than both sideways head tilts \((n = 299)\) and headshakes in which the head turns repeatedly \((n = 106)\). Also, head nods \((n = 321)\) occurred more frequently than repeated nodding of the head \((n = 94)\). Although forward head movements were slightly more frequent than head movements directed backward, right, or left, there was no significant difference between the frequency of head movements produced in the forward-backward \((36\ \text{percent})\) and right-left \((35\ \text{percent})\) dimensions.

With regard to torso movements, figure 5 demonstrates the distribution of different torso-movement types annotated in the data. Forward and backward leans were the most frequent movements, whereas shoulders-up \((n = 34)\) and shoulders-shrugged \((n = 7)\) movements were rare. Right and left turning movements \((n = 65)\) were clearly less frequent in the data than sideways leans \((n = 176)\). As with head movements, there was no significant difference between the frequency of torso movements in the forward-backward \((44\ \text{percent})\) and the right-left \((40\ \text{percent})\) dimensions.

The overall number of left and right turns of the torso was found to be lower than expected, and the movements annotated as right and left turns of the torso were mostly produced only with the shoulders. This may be the result of several factors. First, during data collection, the signers were sitting down, which affects the spinal movements in the rotation (see p. 7). Second, many of the signers produced long stretches of narrative while leaning back in their chair, which seems to have had an even greater impact on the size and complexity of the turn. Finally, because the rotation in turning movements might be hampered while sitting down, many turns may have been replaced by leans of the torso. Alternatively, the same visual effect may have been achieved by rotation of the head and/or signing in the right or left edge of the signing space.

Finally, the results also showed considerable variation in the degree of activeness of the torso and the head of the twelve signers. This variation is shown in figures 6 and 7 for the head and the torso, respectively.
4.2 Timing according to Direction: Simple, Semicomplex, and Complex Combinations

In the analysis of the timing and direction of co-occurring head and torso movements, three different types of torso and head movement combinations were identified in the data: simple, semicomplex, and complex. Simple combinations of co-occurring torso and head movements include only codirectional movements of the torso and the head. In these instances, the head merely moves along with the movement of the torso (see figure 10). In semicomplex and complex combinations, the head also produces other movements even though it obviously
follows the direction of the torso movement. In semicomplex combinations, the signer produces one directionally differing head movement in addition to the codirectional movements (see figure 9). Complex combinations, on the other hand, consist of codirectional movements and several other head and/or torso movements that differ in direction (see figures 15, 16, and 17). The overall frequency of simple, semicomplex, and complex torso and head movement combinations in the data is presented in table 5.

Table 5. Overall Frequency of Simple, Semicomplex, and Complex Combinations of Co-Occurring Torso and Head Movements in the Data

<table>
<thead>
<tr>
<th>Combination Type</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>simple</td>
<td>114</td>
<td>41.6%</td>
</tr>
<tr>
<td>semicomplex</td>
<td>71</td>
<td>25.9%</td>
</tr>
<tr>
<td>complex</td>
<td>89</td>
<td>32.5%</td>
</tr>
</tbody>
</table>

As table 5 shows, slightly fewer than half of the co-occurring torso and head movements formed simple combinations, while 58.4 percent of the combinations were semicomplex or complex. The frequency of these different combinations according to the direction of the torso movement is presented in figure 8.

Figure 8. The frequency of simple (dark gray), semicomplex (gray), and complex (light gray) combinations of torso and head movements according to the direction of the torso movement.
As figure 8 shows, torso movements to the right or left were produced more frequently in complex combinations than simply with codirectional head movements right and left. In contrast, forward and backward torso movements co-occurred most frequently with simple codirectional head movements in these directions. The results indicate that, in the right-left dimension, the torso produces (presumably long) movements, which allow more complexity in co-occurring head movements than do torso movements in the forward-backward dimension.

4.3 Summary

The present study clearly shows that the head is more active than the torso in FinSL narration. The number of different torso movements \((n = 599)\) in the narratives of twelve signers is approximately one-fourth the number of head movements \((n = 2482)\) in the narratives. The results indicate that, even though the head and torso may move together, they do not have to move together in narrative signing: The head is free to produce movements and positions with varying functions without any co-occurring movements of the torso.

The results of the analysis of six narratives show that slightly fewer than half \((n = 114)\) of the co-occurrences of torso and head movements were simple combinations of codirectional movements in which the head followed the torso movement. In particular, forward and backward leans of the torso tended to co-occur with only forward and backward head movements (i.e., thrust, chin-down, pull, or chin-up movements of the head). However, the analysis also shows that the direction of co-occurring torso and head movements frequently reflected complexity: A little more than half of the co-occurrences were either semicomplex \((n = 71)\) or complex \((n = 89)\) combinations, in which the movements are not only codirectional but include simultaneous movements produced in different directions.

5. Functions of Co-Occurring Torso and Head Movements

5.1 Co-Occurring Torso and Head Movements with a Shared Function or Different Functions

According to the analysis, the majority of co-occurring torso and head movements performed essentially a shared function. The overall number of these movement combinations in the four narratives was 140, of which 90.7 percent \((n = 127)\) accomplished the same function. 70 percent \((n=89)\) of these emerged in CA sequences in which the torso and head movements depicted the actions or the existence of a referent in the discourse. In 9.3 percent \((n = 13)\) of the co-occurrences, the functions were different. In table 6 the number of co-occurring torso and head
movements with different functions is presented according to the degree of complexity of the movement combinations.

Table 6. The Number of Co-Occurring Torso and Head Movements with the Same Function and Different Functions according to the Complexity of the Combination

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Same Function (n)</th>
<th>Different Function (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>simple</td>
<td>69</td>
<td>1</td>
</tr>
<tr>
<td>semicomplex</td>
<td>34</td>
<td>4</td>
</tr>
<tr>
<td>complex</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

As table 6 shows, although the overall number of different functions in co-occurring torso and head movements is small, the number of different functions increases as the degree of complexity increases in the movement combinations.

5.2 Functions of Simple and Semicomplex Combinations of Co-Occurring Torso and Head Movements

As mentioned earlier, most of the simple and semicomplex combinations of co-occurring torso and head movements had a common function of depicting referents in discourse. In these CA sequences, the function of the torso and head movements and that of the manual signing was either similar (see figure 9) or slightly different (see figure 10). Furthermore, the data also included sequences of CA in which the simultaneous codirectional torso and head movements represented the action of a referent while the hands narrated the story (see figure 11). This type of depiction has been described as reduced CA (Cormier, Smith, and Sevcikova 2015).
Figure 9. CA sequence in which a semicomplex combination of torso and head movements (lean back, chin-up, head tilt left), together with manual movements, constructs the action of a referent (CFINSL005, S1, BleB-08, and Hchin-up-13).

Figure 10. CA sequence in which a simple combination of codirectional torso and head movements (forward lean, chin-down) locates and depicts the position of a referent (a boy), while the hands construct the dialogue (“Good night”) (CFINSL005, S1, BleF-03, and Hchin-down-03).

Figure 11. An utterance in which a semicomplex combination of torso and head movements (lean back/chin-up; lean right/tilt right) depicts a referent, while the hands change from enacting (PULL-OVER-BLANKET) to narration (GO-TO-BED) and back (PULL-OVER-BLANKET-AND-SLEEP) (CFINSL008, S2, BleR-01, HtiR-02, BleB-01, Hchin-up-04).
In some cases the simple and semicomplex combinations of torso and head movements were more or less gestural and added to the semantic properties of single signs or utterances. Some of these movements were associated with meanings of exclusion or inclusion (see Wilbur and Patschke 1998) and were often difficult to distinguish from the representation of referents in (subtle) CA sequences (see Cormier, Smith, and Sevcikova 2015). Figure 12 provides an example of codirectional torso and head movements that add to the semantic properties of an utterance.

Figure 12. A sequence of signing in which a simple combination of a head pull and a backward lean adds attributes to a manually signed sequence (“coldness”) (CFINSL008, S1, Hpull-10 BleB-02).

In 30 percent \((n = 38)\) of the co-occurring torso and head movements that performed the same functions, those functions were not related to the depiction of referents in CA sequences. Rather, these movements had prosodic functions (e.g., binding stretches of signing into a larger discourse sequence) (see figure 13) or emphasizing single signs (see figure 14).

Figure 13. An example of a structure in which a simple combination of torso and head movements binds signed units prosodically (CFINSL008, S1 BleB-09, Hpull-19).
Figure 14. An example of an utterance in which a simple combination of torso and head movements adds emphasis to WINDOW. The recovery movement of the head begins at the end of the sign. Notice that the body lean is longer in duration (CFINSL008, S2, BleB-04, Hpull-08, Hchin-up-10).

5.3 Functions of Complex Combinations of Co-Occurring Torso and Head Movements

As shown earlier, most of the complex combinations of torso and head movements performed a shared function of representing referents in discourse. In some CA sequences, the torso and head movements emerged almost simultaneously (see figure 15). However, in others, the torso movement was long in duration while the head produced formally different movements (see figure 16). Although most of the complex combinations occurred in CA sequences, some had other functions (e.g., adding to the semantic properties of manually signed sequences; emphasizing; binding long stretches of signing in discourse) (see figure 17). As the complexity of the combination of various torso and head movements increased, differences in their functions grew (see figures 16 and 17). However, in most of these combinations, the torso and head movements performed the same functions (see figure 15).
Figure 15. An utterance in which a complex combination of torso and head movements depicts a referent in a CA sequence (“continuously look out the window”) (CFINSL005, S1, BleR-03, HtiL-2, Hthrust-5).

Figure 16. An example of a complex combination of torso and head movements. The torso movements bind a longer stretch of discourse, including the depicting of referents, while the head movements perform a variety of functions, such as negation (CFINSL008, S2, BtuF-05, BtuL-01, HtuL-29, Htilting-10, Hshake-10, Hchin-down-21–22).
Figure 17. An example of a complex combination of torso and head movements. The torso leans and turns toward a location where a referent was located earlier in the discourse. At the same time, the head movements add to the semantic properties of the narration (THE-DOG-RUNNING-TO-ESCAPE) (CFINSL008, S2, BleR-06, BtuR-01, Hchin-down-19, Htilting-08).

5.4 Differences in the Functions of Torso and Head Movements in the Forward-Backward and the Right-Left Dimensions

Finally, the results of the analysis revealed several differences in the functions of forward and backward torso and head movements. Forward torso and head movements (see figure 13) were used in dynamic bodily depictions in CA sequences that conveyed meanings such as “opening a door,” “going inside,” “digging and searching for something,” and “looking at something.” Backward head and body movements (see figures 12 and 14), on the other hand, were found in depictions of more static positions or states in CA sequences and conveyed meanings such as “looking at a snowman from a distance,” “going to sleep” (or “sleeping”), “sitting relaxed,” and “being amazed.” Backward torso and head movements represented dynamic features of referents in contexts such as “flinching away from the heat.” In addition to CA, forward and backward movements of the torso and head were found to place emphasis on different lexical units in signing (see also Puupponen et al. 2015).

Compared to simultaneous head and torso movements in the backward-forward dimension, torso and head movements in the left-right dimension performed more varied functions. In CA sequences, head and torso movements to the left and the right convey meanings such as “searching,” “looking for something,” and “looking around.” Such movements also appeared in reference tracking in the discourse: They were directed to previously established meaningful locations in the signing space during CA depictions or other parts of the discourse. In addition, left and right movements were found to bind units in the
signing stream prosodically. This same function was also found for backward-forward torso and head movements (see figure 13). However, it occurred more frequently in the left-right dimension. All in all, left-right movements of the torso often included positions of long duration, whereas the head participated in the representation of referents, for example.

5.5 Summary

The results of the analysis reveal that a clear majority (90.7 percent) of co-occurring torso and head movements performed the same function. This was the case regardless of whether the movements formed simple, semicomplex, or complex combinations. However, the difference between functions increased as the complexity of the movement combinations increased. When the co-occurring torso and head movements performed a shared function, the most frequent function was the depicting of referents in constructed action. Other functions for torso and head movement combinations included emphasis, adding to the semantic properties of an utterance, and binding stretches of signing prosodically.

6. Discussion

The results of the current study show that the movements produced with the torso and the head are closely connected components of signing, which nonetheless must be treated as independent activities in certain contexts. With regard to Research Question 1, the analysis of the activity, direction, and timing of torso and head movements shows that the two body parts can move simultaneously and in a codirectional manner but that the head is significantly more active than the torso in narrative texts (see table 4). The total number of different torso movements was approximately one-fourth the number of different head movements in the data of altogether twelve FinSL narratives. This indicates that the head participates in contexts in which the torso does not and, further, that, in contexts where torso and head movements can be produced together, the emergence of a head movement may in many cases be sufficient. However, as can be seen from table 5 on p. 13, the results also show that, if a torso movement emerges, it is produced either together with a simultaneous and codirectional head movement (simple combination) or with co-occurring but directionally different head movements. Of all of the co-occurrences in a subset of six narratives, 42 percent were simple combinations, 26 percent semicomplex combinations, and 32 percent complex combinations of torso and head movements. An important question is whether different levels of complexity of torso- and head-
movement combinations should be taken into account in the phonological description of a sign language (see, e.g., the classification of simple and complex movements in Brentari 1998).

With regard to Research Question 2, the results of the study show that, when the torso and head movements co-occur, they usually also perform the same function (see figures 12–15). In a subset of four narratives, approximately 90 percent of co-occurring torso and head movements had the same functions, of which most (70 percent) were instances of constructed action. This discourse function is well known for body movements in several sign languages (see, e.g., Hodge and Ferrara 2013). Other contexts in which the torso and the head perform the same function are, for example, when binding sequences of manual signs or emphasizing single signs in a discourse (see also Sandler et al. 2011; Sandler 2012; Puupponen et al. 2015; Jantunen 2016).

According to the data, when co-occurring torso and head movements are purely codirectional, the functions are the same for the activity of both the head and the torso. However, differences in the functions emerge as the complexity of the movement combinations increases and the movements exhibit differences in their direction. Eleven percent of the 34 semicomplex combinations and 33 percent of the 24 complex combinations had differing functions in the subset of four narratives. In these co-occurrences, the torso movements are usually relatively long in duration and include a hold or a position of the trunk while the head produces relatively short movements, such as thrusts, tilts, or nods. In these instances the torso movements bind manual units of signing into prosodic sequences, while the head movements perform a variety of functions. These prosodic contours are more frequently produced with sideways leans of the torso than with forward and backward leans. Because forward leans occur more frequently (see figure 5) and are used for other purposes (e.g., emphasis), an interesting question is whether the forward-backward dimension is used less for text cohesion. It may be that, in text coherence and reference tracking, forward leans are used less often than sideways leans (see also Sandler et al. 2011 and Jantunen et al. 2016a).

However, several factors must be taken into consideration when considering the results. Firstly, during the data collection and the signing of the stories, the participants were sitting down, not standing up; moreover, many of the signers were leaning against the backs of their chairs. Sitting is a resting position of the body, and thus it influences the way in which signers move their torso. If a signer is also leaning against the back of a chair, the number of torso movements will very likely decrease, and/or the signer will produce movements in a reduced or otherwise different manner. This, however, allows us to conclude that moving the torso is noncompulsory in many contexts in narrative signing.
Second, the way in which the stories were told may have influenced the number of torso movements. Many of the signers told the stories instead of showing them. That is, they used constructed action less frequently than occurred, for example, in corresponding narratives in Swedish Sign Language (see Puupponen et al. 2016). This may have affected the number of torso movements produced in the narratives. However, as the degree of activeness of the torso and the head has been found to vary in sequences of CA (e.g., Cormier, Smith, and Sevcikova 2015), we cannot conclude that a correlation exists between the number of CA sequences and the number of torso movements in a narrative.

Third, when torso and head movements form simple combinations in which the movements are similar in direction and production (e.g., head pulls and backward leans; head thrusts and forward leans), it is relatively difficult to determine whether the head produces a movement of its own or whether it is merely following the motion of the torso. The results of the current study support the latter interpretation. Actually, it may be that, with these types of body movements, the degree of activeness of the articulators merely increases the amplitude of the movements and the prominence of the contents signed while they are being made. It is an interesting question whether this amplification of movement is comparable to the degree of “loudness” in the larger and smaller forms of signs in manual prosody (see Crasborn 2012).

Fourth, the narratives show a considerable level of variation between individual signers in the degree of activeness of the torso and head (see figures 6 and 7). This may again be a result of the varying degree of telling vs. enacting the contents of the discourse. On the other hand, the variation may also stem from the idiolectic characteristics and styles of individual signers, as well as their age and background.

Finally, but most important, all of the implications of the results are based on an analysis of narrative data. The degree of activeness of the head and the torso will presumably vary according to the different discourse functions and contexts of language use. Narrative data may contain more movements of the torso due to the emergence of CA sequences. However, conversational data have also been found to include various levels of torso and head activity. For example, body leans encode the information structure, some of which has a close connection to the context and environment of a particular discourse (see, e.g., van der Kooij, Crasborn, and Emmerik 2006). The fact that the torso movements in the current study did not occur only in CA sequences supports these findings.

So, in light of the results of the current study, should we consider the torso and head to be one articulator or two separate ones? The results indicate that, although the torso and the head can operate together and are closely connected, they cannot be treated as primarily one
unit. Several factors support this argument. First, as stated earlier, the head is much more active than the torso and produces movements such as single nods, nodding, and headshakes, in which the torso does not participate. Second, the movements of the head and the torso are not always purely codirectional even though they both emerge: Semicomplex and complex combinations of torso and head movements were frequently found in the data. Third, although co-occurring torso and head movements often have a common function, this is not always the case. The functions of torso and head movements are sometimes different, and these differences increased as the complexity of the movement combinations increased. Furthermore, although co-occurring movements of the torso and head perform different types of functions, the functions of head movements vary to a greater extent—from syntactic functions (e.g., negation, questions) to prosodic boundary marking, emphasis, and positive feedback (backchanneling) in discourse. To conclude, because the head and the torso differ in their overall degree of activeness, and because the direction and function of co-occurring movements of the torso and head can differ, we cannot view these two body parts as a single articulator.

However, while keeping this in mind, the results of the current study also prompt one to ask the following question: How should we approach the torso movements if their emergence in many cases depends only on the physical environment and the position of the signer while engaging in discourse? When are they relevant? In the current research, the importance of torso movements came up in two different ways. First, when torso movements were of long duration, they usually performed an independent function. Although they might have emerged with codirectional head movements with a shared function (e.g., CA), their function in many cases became more independent as the torso remained in a static position while the head made other movements. In the utterance shown in figure 16, the forward lean and the left turn of the torso, as well as the codirectional chin-down and left turn of the head, first depict a referent in CA. Then the torso remains in that position while the signer produces a negative headshake, resumes her eye contact with the interlocutor, and signs “he couldn’t find it.” After the headshake, the torso continues to remain in the same position while the head returns to the depiction. In these torso movements, “holding” the position of the torso binds together a sequence of discourse in much the same way as do manual elements (e.g., theme buoys, fragment buoys) (see Liddell 2003).

Second, the importance of torso movements became more evident as the level of complexity grew in the information conveyed. The annotation and analysis of torso and head movements revealed that, when two or more codirectional torso and head movements co-occur (i.e., when codirectional torso and head movements emerge in several dimensions), they may
still perform only one shared function (see figure 11). However, if codirectional torso and head movements (e.g., sideways movements) occur with other codirectional torso and head movements (e.g., forward movements) and, on top of that, with other head movements with different forms, the function of the torso movement becomes more independent and necessary. Interestingly, in the data, these complex clusters of overlapping torso and head movements occurred more frequently during torso movements directed right or left than in the forward-backward dimension.

7. Conclusion

This article presents a study of the relationship between torso and head movements in FinSL narratives. The results show that, although closely connected in articulation, the torso and head are independent articulators with differences in their degree of activeness and in the directions and functions of their movements. In light of the results I suggest that the annotation and analysis of nonmanual activity would benefit from differentiating between torso and head movements. Furthermore, because the results show that the degree of complexity of combinations of torso and head movements varies, it may be beneficial to take this into consideration while describing the phonological characteristics of a sign language. Finally, as nonmanuals often reflect the gestural and prosodic features of discourse, it is important to consider the “whole” that nonmanual activity forms, regardless of any one particular articulator. When forming a theory of nonmanuality, one should focus on the interaction between different body parts and the semantic content of the discourse. The study presented here contributes to this process by shedding light on the connections between the activity of the torso and the head in a sign language. Especially in the context of FinSL, more research is needed on the interplay between the smaller (i.e., upper and lower face) and the larger (i.e., torso and head) nonmanual articulators.

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Notes

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