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Abstract

This article discusses several arguments in favor of the hypothesis that the headshake as a gesture for negation has its origins in early childhood experiences. It elaborates on Charles Darwin's observation that children inevitably shake their heads in order to stop food intake when sated, thereby establishing a connection between rejection and the head gesture. It is argued that later in life the semantics of the headshake extend from rejection to negation—just as it can be observed in the development of spoken language negation. While Darwin's hypothesis can hardly be tested directly, this paper takes a novel perspective and looks at the predictions it makes taking a plethora of sources of evidence into account. The question of how head gestures are used in cultures where the headshake is not a sign for negation or where other negative head gestures are in use will also be discussed.

Keywords: headshake; backward head toss; negation; refusal; speech
accompanying gesture; embodiment

1 Introduction

In a now famous argumentation, British naturalist Charles Darwin (1872, p. 237) speculated that the origin of the headshake used for negation in most cultures can be traced back to an early childhood experience: he observed that when sated, the infant being breastfed inevitably shakes its head to stop drinking. The aim of the present paper is to elaborate on Darwin's observation. While there is much literature surrounding this topic ranging from psychoanalytical studies (e.g., Spitz, 1957), semiotic analyses (e.g.,

Jakobson, 1972), video-corpus analyses (e.g., Kendon, 2002), studies on the geographical distribution on gestures (e.g., Morris et al., 1979) to studies investigating the development of gestures for affirmation and negation in infancy (e.g., Kettner & Carpendale, 2013), this paper goes in another direction. Tackling Darwin's hypothesis directly is anything but easy; the goal of this paper is to look at the predictions it makes. By reviewing the available evidence in favor or against these predictions, I conclude that most of the predictions turn out to be on the right track although for some of the predictions the evidence is stronger while it is weaker for others.

The predictions Darwin's hypothesis makes are that: (i) the headshake should be the most common gesture to express refusal (or, more broadly: negation) in most cultures of the world; (ii) the headshake as a gesture should be acquired very early in life; (iii) that it should also be used by individuals who are not to able learn this gesture by observation, i.e. those born deaf-and-blind; and (vi) that the headshake should be used by other mammals breastfed in a similar way. It will be shown that all four predictions turn out to be mostly accurate, although only with a pinch of salt. While there has been some previous research concentrating on some of these predictions (especially predictions i and ii), this contribution tries to take a more broad approach by looking at a whole set of predictions Darwin's hypothesis makes (including ones that were not explicitly linked to the origin of the headshake, i.e., predictions iii and vi). Additionally, new sources of data will be used when looking at the distribution of head movements in different regions of the world. For example, by looking at data from sign languages, as non-manual signs

like headshakes are usually borrowed from the surrounding hearing culture in these visual languages.

I will also make some remarks on other negative head movements used in some cultures and revisit those movements when discussing Darwin's hypothesis. It will be, *inter alia*, argued that head-movement systems that have so far been described as expressing negation gesturally by a head toss (e.g., in Turkey, Greece, or parts of Italy), in fact do not lack headshakes, but do exhibit different head movements including one to express anaphoric negation (head toss) plus a truth-conditional gestural negator (headshake). It is argued that a lateral movement of the head is one of the simplest—and often the only possible—reaction of an infant to stop food intake. In repeating this process time and again, a connection is established between refusal and the head gesture. Later in life, the gesture is expanded through reduplication to a repeated side-to-side movement. In addition, the semantics of the headshake extends from mere rejection to a broader concept of negation, thereby mirroring the development of negation in spoken language acquisition.

The organization of the paper is as follows. First, Darwin's hypothesis and its predictions will be discussed (Section 2). Each of the four predictions and the available evidence that could possibly speak against or in favor of it will be discussed in a section of its own. In Section 3 the spread of the negative headshake in different cultures is discussed, Section 4 investigates the prediction that the headshake as a gesture for negation is acquired very early, Section 5 is devoted to the question of whether individuals born deaf-and-blind use the headshake, and Section 6 discusses headshakes in non-human mammals. Finally, Section 7 concludes.

2 Darwin's hypothesis and its predictions

Most speculations of the origin of the negative headshake assume that it stems from some form of avoidance behavior, for example avoiding eye contact (e.g., Jakobson, 1970; Vavra 1976) or refusing food (e.g., Kulovesi, 1939; Sugar, 1941; Spitz 1957). In this line of argument, the headshake is some kind of ritualized form of looking away or refusing offered food. The oldest proponent of the idea that the headshake has its origins in refusing food is Darwin (1872, p. 273), who speculated over the suspected universality of the “signs used by us in affirmation and negation”:

With infants, the first act of denial consists in refusing food; and I repeatedly noticed with my own infants, that they did so by withdrawing their heads laterally from the breast, or from anything offered them in a spoon. In accepting food and taking it into their mouths, they incline their heads forwards. [...] It deserves notice that in accepting or taking food, there is only a single movement forward, and a single nod implies affirmation. On the other hand, in refusing food, especially if it be pressed on them, children frequently move their heads several times from side to side, as we do in shaking our heads in negation.

When we follow Darwin's argumentation, a child, when hungry, starts to search instinctively for its mother's breast and begins to suck (although this process is usually

referred to as “sucking” it actually consists of squeezing the milk out of the breast). The searching and sucking start automatically by inborn mechanisms called the “rooting reflex” and the “sucking reflex”, respectively. The rooting reflex finds expression in the fact that the baby will turn its head toward anything that touches its cheeks or lips. The sucking reflex finds expression in the fact that as soon as something touches the baby’s palate, the baby inevitably starts sucking. These reflexes begin to develop in the third month of fetal existence and are already present at birth (Smith et al., 1985).

Once the baby has satisfied its needs and would like to stop drinking, it has to start an avoidance behavior. An avoidance behavior is necessary because the sucking reflex prevents the baby from simply stopping the sucking/drinking. This means the baby must use its head; this appendage is chosen because small babies lack the ability to fully control their hands and arms. To elude the breast the baby has several possibilities, depending on the breastfeeding position. In most cases, however, a backward head toss is not possible because mothers usually hold the baby’s head to support the weak neck muscles and lack of motor control, as depicted in Figure 1. The figure shows some of the most widely employed breastfeeding positions. In the positions A to C, it is impossible to move the head back, and the only escape is a lateral one. The picture in D shows a breastfeeding position where it is possible for the child to move the head back, but even in this case the easier motion would be a sideways one. Note that similar claims can be made for children who are not breastfed, but bottle-fed.

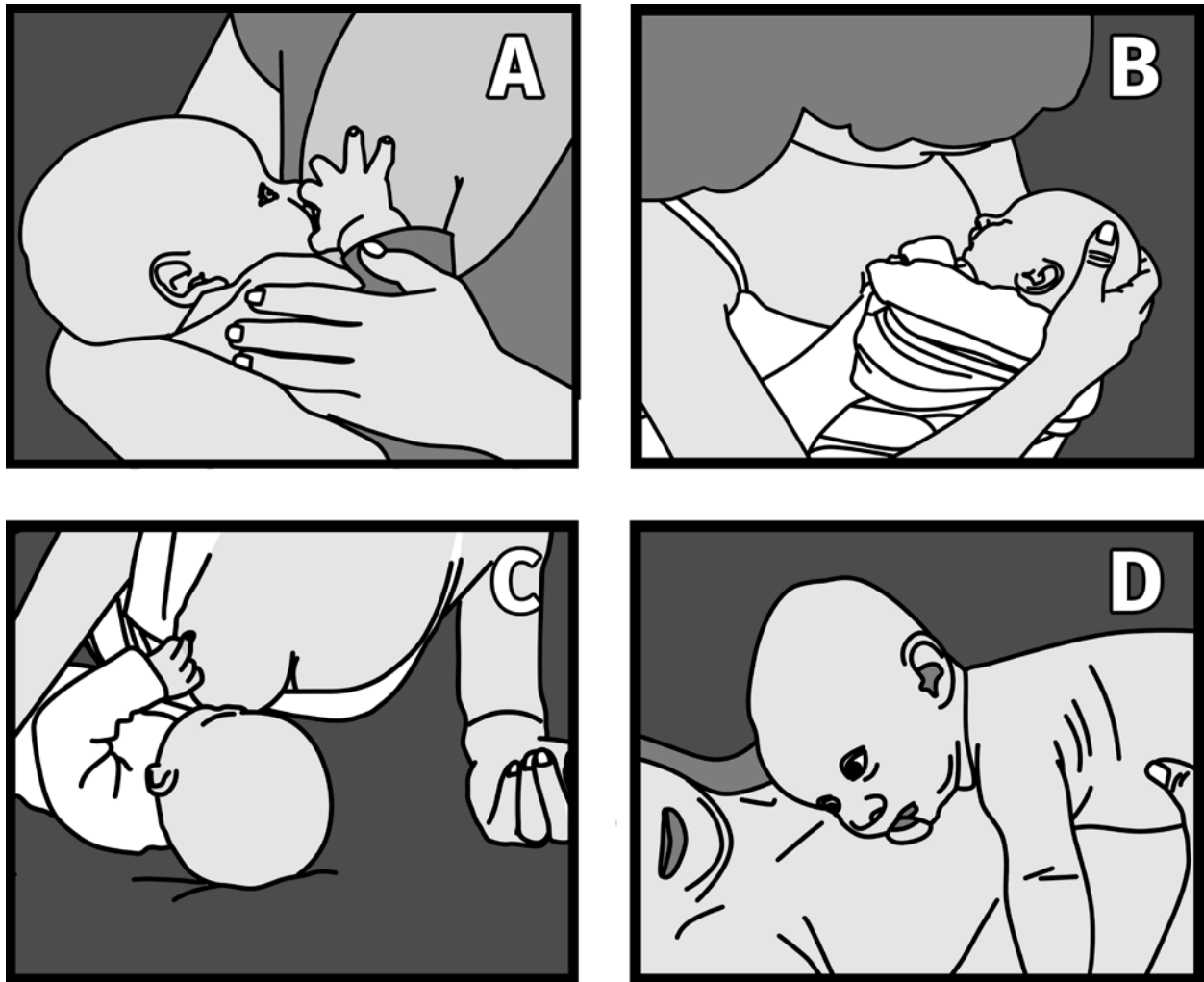


Figure 1: Common breastfeeding positions (see, for example, Meek, 2017)

Interestingly, newborns are unable to hold their heads in an upright position very long, but are nevertheless able to perform active side-to-side movements, at least occasionally, as early as five days after birth (Prechtl, 1989). Indeed, the fetus is already capable of turning the head to the side from about 18 weeks onwards (De Vries, Visser & Prechtl, 1982). Additionally, there is more range horizontally than vertically, i.e., it is easier to move the head to the side than to move it up or down. It seems plausible that when this behavior is repeated several times in early childhood, a connection between

refusal and the horizontal head movement is established—maybe via Hebbian cell learning, i.e., via establishing neural connections between neural networks that are repeatedly active together at the same time.

As well-founded as this argument sounds, it seems hard to come up with an empirical way to test this hypothesis. Even if there is no way to test Darwin's idea in an empirical way directly, it is possible to think of its consequences. Indeed, Darwin's hypothesis makes several predictions:

i. The experiences with breastfeeding described by Darwin should be very similar across cultures. From this, it follows that the headshake should be used for refusal/negation in a similar way across cultures. In other words: headshakes should be the most widespread means of expressing non-verbal refusal/negation as there is a experiential connection between the two. However, as this connection is not innate and only a natural connection between the movement and the concept of refusal exists, it is in fact expected that it is easily possible to culturally overwrite this form-meaning pair.ⁱ

ii. Because the rooting and the sucking reflex start very early, the connection between the lateral head movement and negation/refusal should be established very early as well. Consequently, the headshake as a gesture for negation (or refusal) should be acquired very early.

iii. Because of the way the connection between the head movement and the concept of refusal is established, even deaf-and-blind-born children should shake their heads when expressing negation—even though they cannot have observed this behavior themselves (at least not directly).

iv. The same connection should be established in other mammals who breastfeed in a similar way.

Each of the four predictions is a hypothesis on its own. In the remainder of the paper I will try to review the available evidence which could possibly speak in favor or against each prediction. To anticipate the conclusions: the available data points into the direction that predictions (i) and (ii) turn out to be on the right track while the available evidence for predictions (iii) and (iv) is rather weak.

3 Prediction I: the prevalence of the negative headshake

The goal of this section is to review the evidence available concerning the worldwide distribution of the negative headshake. As systematic studies of the geographical or cultural distribution of head gestures are rather scarce, this section will discuss several sources of evidence. First, some general remarks on different types of universals will be made. Section 3.1 gives a brief overview of different head movement systems. Section 3.2 finally takes the most varied sources of evidence into account which can give us hints about the geographic spread of the negative headshake.

According to Darwin's hypothesis, the connection between refusal (and later negation in general) and shaking the head is grounded in real-world experience. As this connection should be established independently in all humans, this natural association between a mental concept and a body movement should be found all over the world across cultures, i.e. it should be a universal. However, as this connection is not innate, but only develops through some kind of natural process, it is still possible that a culture

might use different means to express negation. Thus, the negative headshake is predicted to be a statistical rather than an absolute universal. In linguistics, statistical universals are usually explained in terms of “how languages develop, how they are used, how they are learned, and how they are processed” (Bickel, 2011, p. 78). The explanation offered in this article follows this tradition, and it is claimed that the headshake is used because of how negation and negative gestures develop in the spirit of Darwin. In those societies where the negative headshake is not used, it is assumed that it is continually overwritten by some other specific cultural practice.

The idea that the negative headshake constitutes a near or statistical universal and the idea that it has some kind of natural or embodied origin are strongly connected. However, some authors claim that it is not possible to state that head gestures in general have a somehow motivated origin as Darwin did. Wagner, Malisz & Kopp (2014, pp. 215–216), for example, refute a motivated origin of head gestures as they do not constitute universals:

However, the possible iconic or universal nature of the relation between e.g. nodding and agreement cannot be postulated, since some well-known reversals exist. In Bulgarian (Jakobson, 1972), where a head upstroke means “no” and in some cultures of the Mediterranean (Greece, Southern Italy, the Balkans) where throwing the head back is associated with negation (Abercrombie, 1954; Jakobson, 1972). The head bobble or waggle, referring to repeated, side-alternating head tilting, is a characteristic head gesture in

India, unknown in Western cultures, used to express backchanneling, friendliness and acceptance.

This is an interesting assessment. When looking at similar cases where we find a great uniformity across cultures, researchers usually do not state that it is impossible to find a motivated origin of such uniformity just because there are exceptions. A prime example is informal kinship terms, which show striking cross-linguistic phonological similarities that usually include a bilabial nasal and an *a*-like sound for the word for mother as in the English word *mama* and a similar word for father starting with a plosive as in *papa*.ⁱⁱ An explanation of this uniformity is that children's phonological development follows cross-culturally stable patterns as argued by Jakobson (1962) in a now famous paper.ⁱⁱⁱ There is substantial support for this hypothesis, although it is not hard to find languages with completely dissimilar words for *mama* and *papa*: in Georgian the reverse pattern is found with the word for mother being *deda* and the word for father being *mama*. Another example of a language not following the general pattern is Warao, where the informal word for father is *dima* and for mother *dani* (Heinen, 1972). Here we do not simply find a reversal, but both words begin with a plosive and a different vowel is used as well.

It is not farfetched to compare the informal kinship terms to negative head gestures. As with the informal kinship terms, we find great uniformity in the world's cultures. As with the words for *mama* and *papa*, we find rare exceptions of this uniformity. Sometimes we find reverse systems in which a nod is used in negative and a shake in positive contexts (the analogy being Georgian *deda* and *mama*). Sometimes we find systems in which a different pattern is found, where a different axis is used as

can be observed with the head wobble or a backward head toss (the analogy being Warao *dima* and *dani*).

For the informal kinship terms, the exceptions found can be simply explained by the well-known fact that the connection between form and meaning is arbitrary (Saussure, 1916)—which of course does not exclude motivation. It is plausible that even words that have some kind of natural origin can be culturally overwritten with an arbitrary form. The same should be true for the negative headshake. What follows from this explanation is that a connection between a side-to-side movement of the head and negation could be established independently in different places and times—finally becoming a conventionalized gesture used by a whole community. It does not exclude the idea that this connection cannot possibly be culturally overwritten by another gesture system. The idea of such an overwriting is supported by the narrow geographical distributions of systems not using a negative headshake, plus the dispersion of the negative headshake in so many culturally unrelated regions in the world, as I will discuss next.

3.1 *Different head movement systems*

Different cultures of the world use different head movements to express epistemic stance. Usually, two distinct head movements exist for the most extreme ends of the epistemic spectrum: one for negation and one for affirmation. Three different systems of head movements to express epistemic stance are traditionally distinguished in the literature: System A, System B, and System C.

Probably the most common system is labeled System A by Jakobson (1972) (for a short overview of its use, see also Kendon, 2002). The system consists of a lateral headshake for negation and a vertical nod for affirmation. The opposite system is called

System B. In this system, a side-to-side headshake is used for affirmation and a vertical nod to indicate negation. Often a third system, System C, is distinguished. In System C affirmation is signaled by a nod or a single head dip forward while negation is expressed by a single backward head toss, often accompanied by a single tongue click (an apical alveolar click). Jakobson's distinction is summarized in Table 1.

	Negation	Affirmation
System A	Lateral head movement (headshake)	Vertical head movement (head nod)
System B	Vertical head movement (head nod)	Lateral head movement (headshake)
System C	Vertical head movement (head toss)	Vertical head movement (head nod)

Table 1: The three head-movement systems used for negation and affirmation according to Jakobson (1972)

3.2 The distribution of the systems

The goal of the following paragraphs is to show that despite the lack of systematic studies on the distribution of different systems, it is possible to state that System A is prevalent in most cultures around the world—at least concerning the negative headshake. This can be seen by studying the gesture systems themselves, by looking at sign language data, or by looking at (historical) data on manual communication systems that include head movements.

3.2.1 Headshakes in spoken languages with System A

Unfortunately, there are nearly no comprehensive studies on where exactly System A is used. Nevertheless, many studies on negative headshakes exist. The goal of this short

section is to list mentions of the use of negative headshakes in different countries/cultures: at least today, System A is used in nearly all Western cultures including Europe, Australia, and the US (e.g., McClave, 2000). The literature additionally mentions the use of negative headshakes as gestures among hearing people in China (Li 2019), India (Rose, 1919; Vaidyanathan 1991), Taiwan (Chang & Wang 2009), Columbia (Saitz & Cervenka 1962), Kenya (Creider 1977), Japan (Hamiru-aqui 2008), Australia (Anderson et al. 2008), Russia, the Czech Republic, Poland (Jakobson 1972), France, Germany (Vávra 1976), Syria, Libya, Jordan, Saudi Arabia, Lebanon, Kuwait, Egypt (Barakat 1973), Sweden (Andrén 2014), Thailand (Zlatev & Andrén 2009), Italy, and Britain (Kendon 2002). This is a surprisingly short list assuming that someone who might encounter a system in which the headshake is not used for negation would with certainty write about communicative problems with this culture mentioning that she or he uses negative headshakes, while others do not (or the other way around).

While the literature cited above consist of more or less isolated mentions of uses of a negative headshake, there is one large comparative study on gestural similarities and differences across cultures which also considered headshakes. Matsumoto & Hwang (2012) presented videos of gestures, including headshakes and nods, to participants from East Asia (China, Japan, and South Korea), Latin America (Mexico, Guatemala, El Salvador, and Brazil), Africa (Kenya, Ghana, Nigeria, and Niger), South Asia (India, Pakistan, and Nepal), the Middle East (Syria, Turkey, Jordan, Afghanistan, Lebanon, and Egypt), and Western cultures (USA, Germany, and Canada). Participants were asked about the intended messages of the gestures shown to them in their respective cultures. Matsumoto & Hwang's (2012) results show that 99.10% of their 516

participants recognized the headshake as a gesture expressing disapproval (and 98.18% recognized a head nod as a gesture of approval). This, again, can be considered strong evidence of the extreme prevalence of System A in the world's cultures. A summary of countries from which the use of a negative headshake was reported is shown in Figure 2.



Figure 2: Countries in which the use of a negative headshake was reported in the literature.

3.2.2 Headshakes in sign languages

The domain of non-manual markings, especially the domain of negative head movements, in sign languages is well-investigated for a variety of typologically and geographically distant sign languages. This has led to an asymmetrical development in sign language and gesture research: there is more information available on negative head movements in sign languages than there is data on negative head gestures used

by hearing people. Thus, it makes sense to look at sign language data because most sign languages of the deaf developed when surrounded by a hearing culture. It is generally assumed that grammaticalized non-manual forms, such as (negative) headshakes, are adapted from the hearing culture (Meier, 2002, p. 13; Sandler, 2009, p. 945; Pfau, 2015), so this kind of data can tell us something about the gestures used in the particular area in general.^{iv}

In her study on 38 typologically and geographically distant sign languages from all continents, Zeshan (2004) observes that all 38 use a headshake in sentential negation (see also Zeshan, 2006; Sandler & Lillo-Martin, 2006, p. 358; Quer, 2012)—although in some it is obligatory and in some it is not. However, also sign languages in which the headshake is not an obligatory marker of negation exhibit negative headshakes: “Even sign languages that use other head movements also have a side-to-side headshake in addition to the other possibilities” (Zeshan, 2004, p. 11). Of special interest are cases in which the surrounding society does not use System A. In the Eastern Mediterranean region, for example, a negative head toss is used in both the sign language and by the surrounding hearing culture. This is the case for Lebanese, Jordanian, Turkish, and Greek Sign Language. These sign languages, however, also make use of a negative headshake (Zeshan, 2004; 2006; Antzakas, 2006; Quer, 2012). Additionally, in some areas where the backward head toss is used in the hearing culture, it is completely absent in the sign language, and a negative headshake is used instead. This is the case in Italian and Israeli Sign Language (Hendriks, 2007). In whatever way the headshake may have entered the respective sign language, Zeshan’s data indicates that the headshake is prevalent all over the world, even in areas where the negative headshake

is (claimed to be) not used by the surrounding hearing culture. This is at least true for those sign languages included in Zeshan's study used in areas where System C (e.g., Italian Sign Language) is prevalent. The situation for sign languages used in regions where System B is used is less clear.^v



Figure 3: Overview of the sign languages under discussion in Zeshan's (2004) typological study. All sign languages in this map make some use of a negative headshake. Each star in the map represents a country in which one of the sign languages is used.

An overview of the sign languages included in Zeshan's study is given by the map in Figure 3 (a list of the sign languages is additionally given in the appendix). As can be seen, a headshake is used in sign languages all over the world, corroborating the assertion of a negative headshake as a quasi-universal. Although Zeshan's study did not explicitly look at how refusal is expressed, given what is known about sign languages, it is likely that refusal is expressed by a combination of a manual sign plus a headshake in most sign languages (see, for example, the study on American Sign Language by Fisher

2006). However, even if the sign language data discussed so far is concerned with truth-conditional negation, I will argue that during language (as well as gesture) acquisition the semantics of the expressions for negation expand from refusal to a more broad concept of negation (see Section 4).

3.2.3 Headshakes in alternate sign languages

Apart from those sign languages that are full-fledged natural languages, many manual-gestural communication systems evolved in various cultures for different purposes which are called “alternate sign languages” (Kendon, 1988), “secondary sign languages” (e.g., Pfau, 2012), “gestural (communication) systems” (Goldin-Meadow & Mylander, 1984), or “kinesic codes” (Kendon, 2004). In some cases such alternate sign language evolved due to a vow of silence (e.g., monastic sign languages), while in other cases oral communication was impossible due to noise (e.g., sawmill sign languages) (see Pfau, 2012). Finally, some alternate sign languages evolved to overcome speech barriers. This is documented, for example, in Plains Indian Sign Language (PISL), an interlanguage which was used in the United States and Canada. PISL is an interesting case to discuss here, because it may offer a possibility to gain insight into the gesture system used by Native Americans before European contact. While it is not clear how old PISL actually is, evidence suggests that it existed long before European contact (Wurtsburg & Campbell, 1995). It would be further support of the idea of the negative headshake as a near universal if PISL users—constituting a vast array of different subcultures cut off from the influence of Western cultures—had used a negative headshake. Nineteenth century descriptions of PISL indicate that it indeed used a negative headshake (Clark, 1885, p. 271). There are also many reports of early

European travelers making notes on PISL, but in none of them is it mentioned that they would make use of unusual head movements for negation—other unusual characteristics, e.g., that many Native Americans used tongue clicks when speaking, on the other hand, are directly mentioned in these reports (see Wurtsburg & Campbell, 1995 for details). While it is still possible that the headshake may have entered the system only later due to contact with Europeans, this is rather unlikely. Thus, it could be assumed that System A was used in this area as Clark (1885) also reports positive head nods. The same is true for similar alternate sign languages used by various native tribes in Australia, at least when it comes to the negative headshake (Cameron, 1881, p. 4, as cited in Kendon, 1988, p. 39).

Hence, even in those manual communication systems which developed independently in unrelated cultures on different continents (and before these cultures had contact with Western gesture systems), the headshake as a sign for negation has been documented. It can be inferred that, most likely, System A was used in North America and Australia (or at least in parts of it). Now that sign languages of the deaf and manual-gestural communication systems have been discussed, the next section is devoted to head movements used for negation different from headshakes accompanying spoken languages.

3.2.4 Headshakes in spoken languages with System B and C

System A seems to be, as argued in the previous subsections, the most common one. The opposite system, however, System B, is also found in some societies. It is, for example, found in Bulgaria. This system may be rare but it is found not only in Bulgaria, but also in neighboring territories, e.g., in Kosovo, Macedonia (e.g., Hentschel, 1998),

Albania, and in more distant regions such as Afghanistan—however, systematic studies of the spread of System B in these countries do, to the best of my knowledge, not exist (but see the study by McClave et al. 2007 who study head movements in different cultures, but from a backchanneling perspective). Additionally, there is one (rather vague) description of a positive headshake used among Sinhala speakers in Sri Lanka (Premavardhena, 2007) and mentions of the use of the head bobble in India (Wagner, Malisz & Kopp, 2014). Even if this is the only report, I will treat the Sinhala community as belonging to System B until counter-evidence becomes available.

The third system, System C, will be discussed in some detail here because it will be argued that it in fact also exhibits negative headshakes. Again, this system displays narrow geographical limitations, being found, for example, in Greece, Turkey, and Southern Italy (Morris et al., 1979; Collett & Chilton, 1998; Kita, 2009). Although the literature reports that a backward head toss is used in those areas, it does not seem to simply replace the negative headshake, but both rather exist simultaneously serving two similar but still distinct functions: the headshake is used as a truth-conditional operator, while the head toss is a marker of refusal as will be shown in the following.

In all three countries, i.e., Greece, Turkey, and (Southern) Italy, backward head tosses are used as negative gestures along with negative headshakes. Indeed, a head toss and a headshake can be used with the same utterance, as exemplarily depicted in Figure 4. The figure shows a native speaker of Greek uttering the sentence in (1).

- (1) Oxi re den thelo
 NEG anyway NEG want-1SG
 ‘No, I don’t want that.’

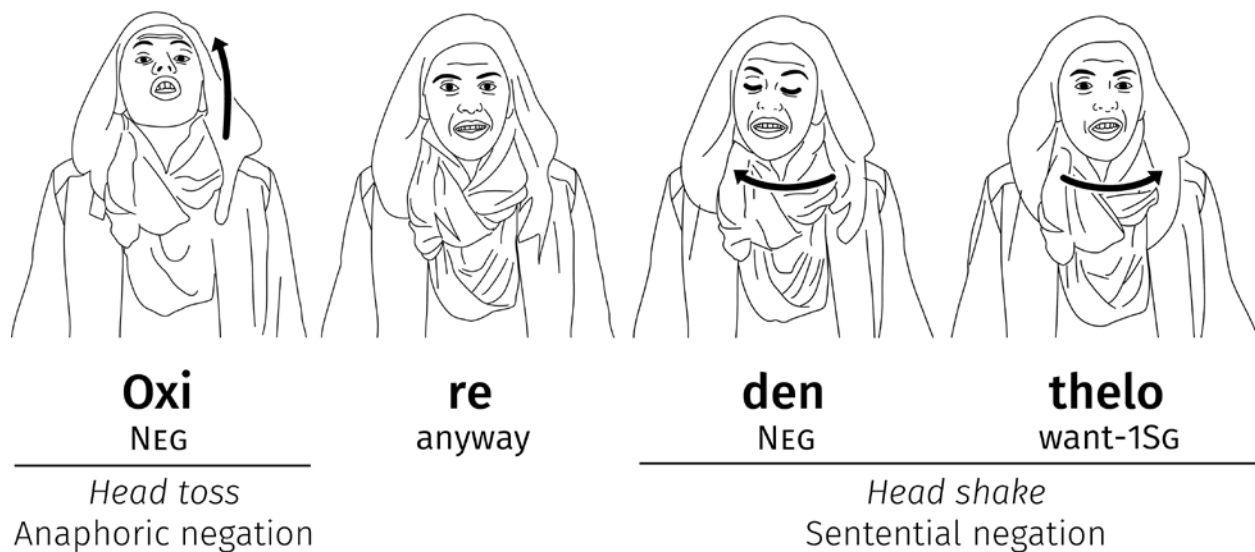


Figure 4: A Greek woman performing a backward head toss and a headshake while uttering *Oxi re den thelo* ('No, I don't want that').

The backward head toss is used as a marker of anaphoric negation (*oxi*)—i.e., a negation that is used to object to a previous utterance and as a link to the discourse—and the headshake as a marker of sentential negation simultaneously with the negated VP (*den thelo*). It seems plausible to view the head toss as a negative response to a question and the headshake as a marker of sentential negation which can be produced across VPs—and also across longer VP strings because of its continuous character. Thus, the backward head toss and the headshake are not only formally, but also functionally distinct.^{vi} The native speakers I consulted (i.e., native speakers of Greek, Turkish, and Southern Italian, all born and raised in their respective countries) agreed that a negative head toss only over the verb (the translational equivalents of *want*) in a sentence like the one in (1) would result in an unnatural utterance. By contrast, all would

accept the sentence with the backward head toss on the sentential negator only. In this case, the sentence, again, gets a rejection reading.

An additional method of providing evidence for the claim that System A is the most common is to investigate those areas where System A is not implemented. If we assume that there are areas in the world where a head gesture different from the headshake is used in negative contexts, we would expect many reports of such gestures in (Western) literature because it should be more likely to report a system deviant from one's own than a familiar one. Interestingly there are not many such reports. Additionally, a closer look at these reports reveals that they refer to a limited set of cases.

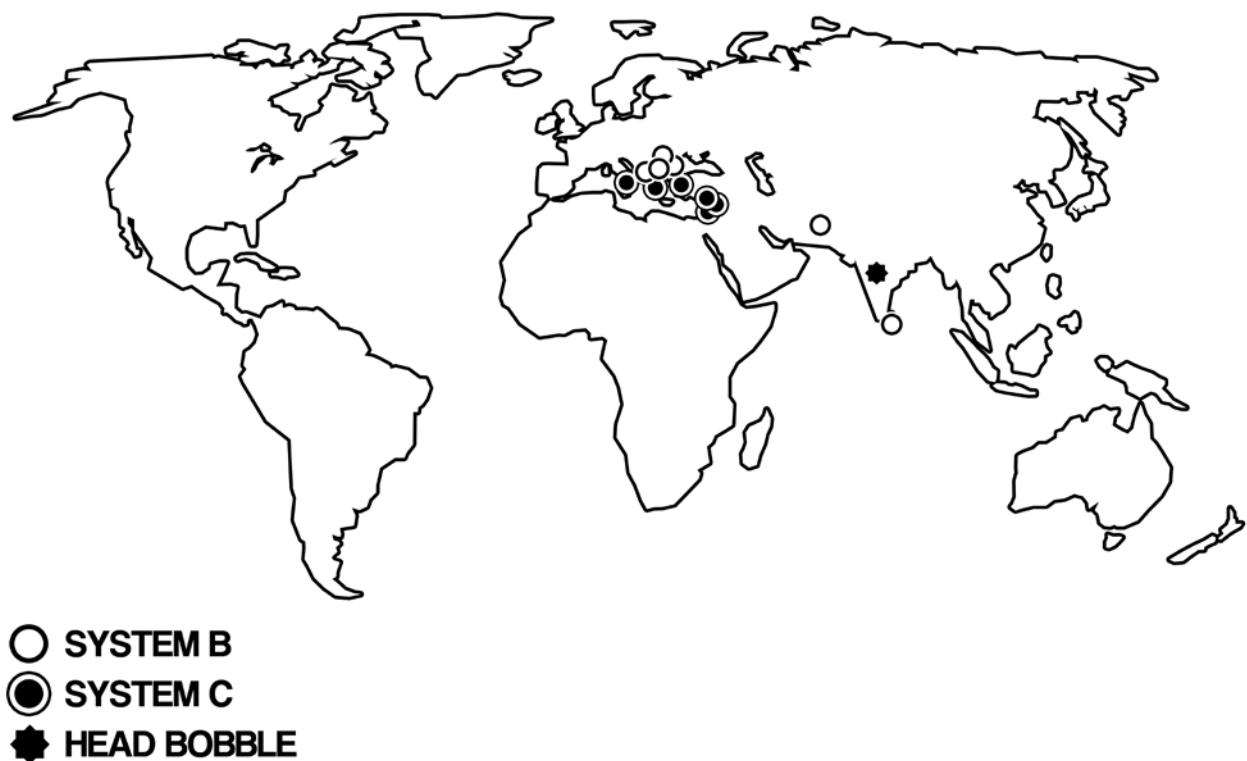


Figure 5: Countries for which it was reported that System A is not used.

The literature reports that a system different from System A is used in some countries in the Mediterranean region and in the Middle East. The map in Figure 5 shows those countries. As can be seen, System C was reported to be used only in Greece, Southern Italy, Turkey (Morris et al., 1979), Lebanon, Jordan, and Israel (Hendriks, 2007). System B is used only in Bulgaria, and maybe in Macedonia, Albania, Kosovo, Afghanistan, and possibly by Sinhala speakers in Sri Lanka. Although there is not much data available about where exactly System A is used, the distribution of the other systems shown in the map suggests that it is used in nearly every part of the world.

Interestingly, most countries in which a system different from System A is used form geographic clusters, as can be seen on the map. On the whole, there is a surprisingly small number of cases where System A is not used, or to be more precise, where head gestures other than a negative headshake were reported. This is especially true if one takes into account that the probability that such deviations would be reported, for example by travelers, should be very high. Additionally, a report of a negative head gesture different from a negative headshake does not imply that a negative headshake is totally absent in the respective culture (as argued for the cases of Turkey, Greece, and Southern Italy). Taken together, a negative headshake can be found in almost all cultures of the world.^{vii}

4 Prediction II: early acquisition of the headshake

As argued above, the headshake as a gesture expressing negation should be acquired very early. Indeed, the first expression of negation in young children is a side-to-side

movement of the head, which is used at around the age of 1 year and 1 month for the purpose of refusal. This renders the headshake one of the first gestures to be acquired (Bates et al. 1979; Eriksson & Berglund 1999; Guidetti 2005; Zlatec & Andrén 2009; Benazzo & Morgenstern 2014). Only later on, between 1 year and 3 months to 1 year and 5 months, do they start to produce verbal expressions for negation (Pea, 1980; Fenson et al., 1994; Guidetti 2005). Interestingly, children tend to use the lateral head movements almost exclusively for rejection, and not in a truth-conditional sense as adults do (Bloom, 1970; Pea, 1980; Guidetti, 2005; Fusaro, Harris & Pan, 2012). Later on, the semantics of the headshake extends from rejection to other uses of negation, including truth-conditional ones—similar to the development of spoken negative expressions which are also first used for rejective and only later on for truth-conditional purposes (see e.g., Stern & Stern, 1907, p. 236; Bloom, 1977; Pea, 1980; Choi, 1988; Hummer, Wimmer & Antes, 1993; Dimroth, 2010). This was shown for example in a study by Fusaro, Harris & Pan (2012) studying 14-, 20-, and 32-month-old children. They found that the headshakes of the 14- and 20-month-olds predominantly conveyed refusal, and that this usage strongly declined in 32-month-olds. Thus, the repertoire for which the headshake can be used expands to more negative categories. This is in line with Darwin's idea that the headshake is rooted in refusal. A similar observation was made for sign languages, which suggests that they follow the same path as hearing children: the first function of negation being refusal expressed by a headshake. Then the concept of negation expands to other uses, including truth-conditional ones, which are not expressed using gestures, but by using language (in the case of sign language users, this is either also a headshake or a manual sign, acquired around 18 and 20

months, see Anderson & Reilly, 2002 and Reilly & Anderson, 2002). Finally, the headshake can be used to express these functions too.

Following this logic, the development of the negative headshake would be like the following. First, children naturally turn their head to the side to refuse food-intake. An instructive example of this behavior comes from a 12-month-old toddler from a diary observation study by Kettner & Carpendale (2013: 199):

She always rejected food by turning her head to the right (and only to the right). She used to cry while she did it, but now it's just a quick head jerk to the side and I know she's not going to eat it.

In repeating this process time and again, a connection is established between refusal and the head gesture. Later in life, the gesture is expanded through reduplication (probably as a means of intensification) to a repeated side-to-side movement. As this is a learning process, the linking of the headshake and refusal may take some time. As reported by Kettner & Carpendale (2013, p. 205): “There is [...] some developmental distance between a head turn and shaking the head”. This process, of course, is a simplification because there will always be an influence by observing grown-ups using the headshake as a gesture of negation (an issue that will be addressed in the next section). It seems as if it not only takes time to establish a connection between refusal and the headshake (cf. Kettner & Carpendale, 2013), but it also takes some time to establish a connection between other semantic functions of negation and the headshake as suggested by the results of the gesture and language acquisition studies cited above (Bloom, 1977; Pea, 1980; Choi, 1988; Hummer, Wimmer & Antes, 1993; Anderson &

Reilly, 2002; Reilly & Anderson, 2002; Dimroth, 2010). Such functions include responses to questions or syntactic uses (Fusaro, Harris & Pan 2012, p. 446 give the following examples for these uses: “using a Cookie Monster puppet, mother asks ‘Do you have any cookies little boy?’ Child shakes head ‘no’” and “playing with a toy house, child shakes his head while static, ‘That room doesn’t have, um, any toys’”).

Taken together, the prediction that the headshake is acquired early in life turns out to be correct. What is unclear, however, is what happens with individuals growing up in a System B environment. If Darwin’s hypothesis is on the right track, then we would expect the connection between the headshake and refusal/negation to be present in those individuals too.

5 Prediction III: headshakes in humans born deaf-and-blind

If the headshake is acquired as described by Darwin, then it should also be used as a negative gesture in deaf-and-blind-born individuals who never had the chance to observe the gesture. In addition, the absence of auditory input prevents them from being told about gesture usage. In an early study on gestures in congenitally deaf-blind children, Goodenough (1932, p. 328) notes:

While the behavior of such cases is unquestionably affected by the results of their own experience, this experience does not include observation and imitation of the behavior of others, nor, previous to training in language, can any except the most primitive and essential standards of behavior be communicated to them.

If Darwin's line of thinking is correct, the negative headshake should not only be observable in blind (where headshakes are found; cf. Iverson et al., 2000), but also in deaf-and-blind individuals. The available evidence for this claim reported in the literature will be discussed in this section. In one study examining a 13-year-old congenital deaf-and-blind girl, who had some residual hearing ability, headshakes could indeed be observed (Deasy & Lyddy, 2009). This study reports that the girl could answer simple questions like "Do you want a drink?" using nods and headshakes (due to the residual hearing it was possible, in this case, to communicate to a limited extent via language). Of course, of more interest are those cases where the individuals under consideration do not have any residual hearing.

This was the case in an early study by Goodenough (1932), who reports headshakes as an aversive reaction in a 10-year-old deaf-and-blind-born girl. Eibl-Eibesfeldt (1973), studying the behavior of 7-year-old blind-and-deaf-born Sabine, also reports the observation of headshakes as a sign of refusal (linguistic communication was not possible in these cases):

[...] Sabine could be made angry either by repeatedly offering a disliked object or by persisting in social contact attempts when she was not willing. She would then turn away abruptly, shaking her head from side to side, finally jerking it backwards, closing her mouth firmly and sometimes biting against her lower lips or clenching her teeth. (Eibl-Eibesfeldt, 1972, p. 180)

These studies seem to indicate that headshakes are not a form of behavior that is learned through observation. The existence of System B furthermore suggests that it is not a reflex-like innate behavior (and can be culturally overwritten). Thus, at first sight, one could conclude that those reported uses of headshakes in deaf-and-blind-born individuals have some kind of natural origin—as the one proposed by Darwin. Also in line with Darwin, the reported headshakes are used for refusal. One problem with the reported studies is, as the reviewers correctly remarked, that the children were rather old (10 and 7) and the possibility that they were implicitly (or even explicitly) taught to use negative headshakes cannot be excluded. This means that the negative headshake could also have entered the children's communicative system as a co-construction through dialogue. Thus, more studies in this domain are clearly in need.

6 Prediction IV: headshakes of other mammals

Most nonhuman mammals, e.g., pigs, are breastfed when the mother is either lying on her side or standing, as depicted in Figure 5B and 5C. These animals therefore do not need to perform a horizontal head movement to stop the feeding. It is sufficient for them to lower their heads, a movement supported by gravity (or they can simply step back, if possible). The special posture of human babies, in contrast, makes non-lateral head movements difficult. There are, however, other nonhuman mammals that breastfeed their babies in a similar way. An example for these mammals is bonobos (*Pan paniscus*), as shown in Figure 5A. Following Darwin's argumentation, and provided that bonobos are able to understand and use some form of negation, they should also shake their heads, or more broadly, use lateral head gestures, for negation. The latter

assumption can be made, at least when it comes to the most simple function of negation, namely in contexts where the animals want to make an effort to prevent others from engaging in some sort of behavior (which can be argued to be a kind of refusal).

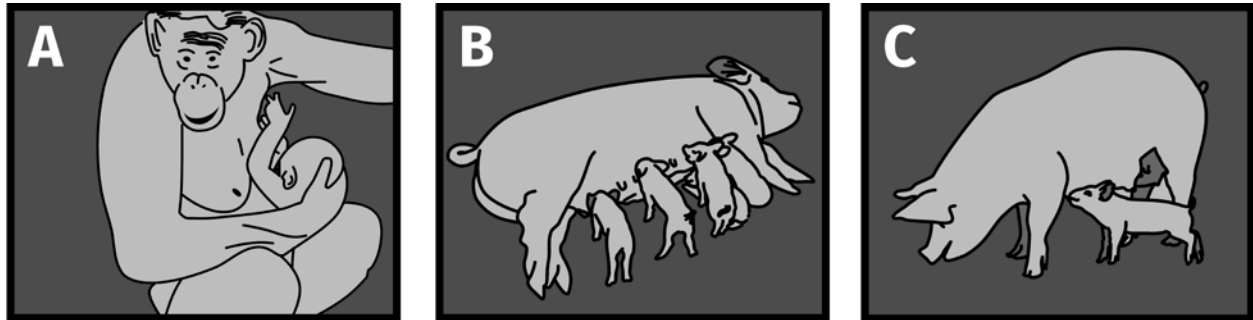


Figure 6: A bonobo mother breastfeeding her child. B and C: Pigs, as well as most mammals, breastfeeding their children either in a lying or standing position

Breastfeeding behavior similar to humans is found in many apes and monkeys. Two cases can be distinguished when looking at these apes and monkeys. Those from which no lateral head gestures were reported and those from which lateral head gestures were reported. If lateral head gestures are reported further distinctions can be made regarding their communicative functions. The head movements may: (i) serve unclear functions/have unclear meanings, (ii) may have non-negative meanings, or (iii) may serve as more or less clear negative communicative signals. In general, non-human primates who breastfeed their babies in a similar way as humans include the great apes (orangutans, gorillas, chimpanzees, and bonobos), the lesser apes (gibbons), Old World monkeys (e.g., mangabeys), New World monkeys (e.g., capuchins), and lemurs.

Non-human primates which breastfeed their babies in similar ways as humans from which, to the best of my knowledge, no headshakes were reported in the literature

include orangutans and the species of lesser apes (gibbons). To be more precise, head gestures in general seem to play no role in the communicative behavior of orangutans (*Pongo pygmaeus*) (Liebal, Pika & Tomasello, 2006; Cartmill & Byrne, 2010). The situation is similar to the various species of lesser apes (*Hylobatidae*), where the few studies available contain no reports about headshakes or turns (see, for example, Tomasello & Call 1997; Libal, Pika & Tomasello, 2004). It has to be stressed, however, that there is still not much known about the communicative behavior of apes and monkeys, especially not under natural conditions (cf., for example, Tuttle, 2014).

Although there are no reports of lateral head movements from orangutans and lesser apes, there are reports from Great apes (e.g., bonobos), Old World monkeys (e.g., mangabeys), New World monkeys (e.g., capuchins), and lemurs. In the following, I will discuss lateral head movements with unclear meanings, those with non-negative functions, and finally those with negative functions. However, the line between non-negative and negative functions remains unclear as there is room for interpretation concerning the question of what counts as a negative meaning.

Lateral head movements with unclear functions were observed in chimpanzees and gorillas. Kortlandt (1969) and Waal (1982) both report headshakes in chimpanzees, but stress that human influence could not be excluded in their studies. Hobaiter & Byrne (2011), however, also report headshakes in wild chimpanzees, but again their intention remains unclear. Similarly, Tanner et al., (2006) report headshakes from gorillas living in zoos and in the wild, but again with unclear intentions (see also Pika, Liebal, & Tomasello, 2003; Genty et al. 2009; Tanner & Perlman, 2017). Tanner et al. (2006) also mention, however, head turns as an avoidance behavior at least in zoo-kept gorillas.

While avoidance behaviors could be interpreted as negative (see below) some non-human primates seem to use lateral head movements for non-negative functions. The most prominent function is solicitation. Wild capped langurs, for example, were reported to use headshakes as part of solicitation behavior (e.g., Solanki, Kumar & Sharma, 2007). Additionally, headshakes to solicit play were reported in many African great apes, including chimpanzees (van Hoof, 1973), gorillas (Tanner et al., 2006), and bonobos (Pika, 2007).^{viii}

While lateral head movements to signal truth-conditional negation seem to be absent in apes and monkeys there are some functions of the headshake in non-human mammals which can be interpreted as having some negative function. As already mentioned above, zoo-kept gorillas were observed to use head turns as an avoidance behavior. Similar observations come from other species. Ruffed lemurs, for example, were observed to use head turns as a submissive behavior, probably as a means to avoid eye contact (Pereira, Seeligson & Macedonia, 1988). This fits in well with the idea that the origin of the headshake lies in some sort of avoidance behavior (cf. Jakobson, 1970; Vavra 1967 and Section 2). The same behavior is found with some New World monkeys (Ceboidea): "Eyebrow lowering [...] occurs in many of the Ceboidea, from marulosests such as *Oedipomidas* to the advanced capuchins [...] during friendly but hesitant approaches to a fellow and in similar situations. It is commonly accompanied at intervals by lateral head shaking and by eye closure. In capuchins, in particular, the resemblance of such a display to the full pattern of protective responses elicited by a nauseous taste, for example, is marked" (Andrew 1963, p. 1035). The clearest cases of negative lateral head movements, however, come from bonobos. Zoo-kept bonobos

were observed to shake their heads to signal negation (or a precursor of negation) in preventative situations (Schneider, Call & Liebal, 2010; Pinfield, 2013). This was, for example, observed when mothers were trying to prevent their children from performing a certain behavior, e.g., to stop them from playing with a plant (I also refer the reader to the supplementary files in Schneider, Call & Liebal, 2010; Pinfield, 2013 which include video materials):^{ix}

Example 1: The mother and her female offspring were sitting next to each other on the ground. The offspring started crawling away toward a nearby tree trunk and proceeded to climb. The mother retrieved the infant and positioned her back to her side. The infant made continual efforts to climb the trunk, and each time the mother retrieved her. This culminated in the mother seizing the infant by the leg and shaking her head while looking toward her. The infant climbed once again, this time moving around the tree (now out of sight of the mother). After awhile, the mother got up, moved around the tree, grabbed the infant's arm, and pulled her to the place where they originally sat. When releasing the infant the mother looked at her and shook her head once more. The mother started grooming another group member, and the infant moved toward the tree again.

Example 2: The mother and her female offspring were sitting next to each other on the ground while the infant manipulated a piece of leek. After awhile, the mother took the leek from the

infant and threw it to the side. Eventually, the infant retrieved the leek and the mother tried to recapture it. The mother shook her head twice while doing so and threw it away from her again. The infant continued to move toward the piece of leek. (Schneider, Call & Liebal, 2010; Pinfield, 2013, p. 200)

Everything considered, we have evidence that there are some non-human mammals that breastfeed their young in a similar way to humans, using lateral head movements also in what can be called negative contexts. The literature on great apes refers to these gestures as being used in preventative contexts. As illustrated by the examples cited above, this means that the ape shaking its head seems to have the intention to stop another ape from performing an action. This may not be exactly an action of refusal, but it is nevertheless in line with Darwin's idea. However, according to Darwin's hypothesis one would have expected more reports on non-human primates using headshakes also in contexts different than prevention. On the other hand, there is, to the best of my knowledge, no report on mammals, that breastfeed their young in a lying or standing position, explicitly displaying negative headshakes. Thus, the literature on apes and monkeys at least partly supports Darwin's hypothesis; although it does not present very strong evidence, the missing reports on headshakes in orangutans and other apes and monkeys do not directly speak against it. One open question relates to the question why headshakes have been reported in preventative situations, but not as a sign for refusal in other situations (e.g., when offered something that they do not want). One tentative answer to this question may, as correctly pointed out by a reviewer, be that apes often

do not have the need to communicate refusal as they might simply not participate in a joint action or can just ignore an offered object.

7 Conclusions

The goal of this paper was to look at the predictions made by the hypothesis that the headshake as a gesture of negation has its origin in early childhood experiences—an idea going back to Charles Darwin who speculated that the connection between negation and the headshake stems from early childhood experiences of turning the head away in order to stop food intake. The predictions looked at were: (i) that the headshake should be found in nearly all cultures of the world, (ii) that the headshake should be acquired very early in life, (iii) that it should be found as a gesture in individuals being born deaf and blind, and (iv) that the headshake should be found in non-human mammals being breastfed in a similar way to humans.

Concerning the prediction that the headshake should be the most wide-spread gesture for negation, the available evidence suggests that this is indeed the case, i.e., negative headshakes are found all over the world, although some rare exceptions exist. These exceptions, however, do not speak against Darwin's hypothesis as it is not unexpected that the negative headshake can, in some cases, be culturally overwritten by other gestures. The second prediction is also supported by the information available. The headshake as a gesture of refusal/negation is indeed one of the earliest gestures acquired by human children. While the evidence for the first and the second hypotheses is in line with Darwin's idea, the situation is much less clear with the other two predictions. The data available from deaf-blind individuals on the one hand supports

Darwin's idea as negative headshakes are found in these individuals. The data is, on the other hand, very scarce and from the descriptions available, the possibility that the headshake entered the gestural repertoire of deaf-blinds by implicit or explicit instruction cannot fully be excluded. Similarly, the evidence available in favor of the fourth prediction, namely that non-human mammals being breast-fed in a similar way as humans also use headshakes for similar negation-related functions is scarce. The clearest case discussed were bonobos shaking their heads to prevent others from performing an action. When it comes to other apes and monkeys the evidence is, however, at best mixed. While some non-human primates were reported to use lateral head movements, their exact function often remains unclear and for others no reports exist at all. While this is not great support of this prediction, it does, however, also not constitute counter-evidence.

While the first and the second predictions have been looked at in isolation, this paper is the first discussing the third and the fourth prediction in relation to Darwin's hypothesis and the first trying to bring together as much evidence as possible in support of it. The discussion presented furthermore underlines the problems which come with Darwin's hypothesis. Not only is it hard to come up with empirical ways to test it directly, but the predictions it makes are also not unproblematic as evidence against the predictions will not suffice to reject the hypothesis (although the predictions, in general, seem to be more or less correct). The paper also unveiled that there are several research gaps which need to be addressed before it can be really stated that all the predictions are completely met or not: large-scale cross-cultural comparisons of the use of head gestures are still rare and in great need. More research on the use of gestures in

congenitally deaf and blind individuals needs to be done, especially with young children and more research on the use of lateral head movements in non-human mammals and their meanings would also be highly welcome.

Taken together, the presented discussion suggests that the negative headshake is a statistical universal acquired very early in life that is also used by individuals who have not had the opportunity to directly observe it (i.e., congenitally deaf-blind individuals) and leastways by some non-human primates in a similar way as humans. This, at least partly, supports the idea that the headshake as a gesture of negation has its origin in a natural behavior in early childhood. This is in line with research suggesting that many gestures have their roots in object manipulation or action, especially within parent-child interaction (Acredolo et al., 1999; Bruce, 2005).

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Appendix: List of Sign Languages Used in Zeshan (2004)

American Sign Language (ASL): United States and Canada except Quebec	Auslan: Australia
British Sign Language (BSL): UK	Chilean Sign Language: Chile
Chinese Sign Language: mainland China	Dansk Tegnsprog: Denmark
Deutsche Gebärdensprache (DGS): Germany	Finnish Sign Language (Suomalainen viittomakieli): Finland
Greek Sign Language: Greece	Hong Kong Sign Language: Hong Kong
Íslenskt táknmál (Icelandic Sign Language): Iceland	Indo-Pakistani Sign Language (IPSL): India and Pakistan
International Sign	Irish Sign Language: Ireland
Israeli Sign Language: Israel	Kata Kolok: Bali
Kenyan Sign Language: Kenya	Langue des Signes Française (LSF): France

Langue des Signes Quebecoise (LSQ): Quebec, Canada	Lengua de Señas Argentina: Argentina
Lengua de Señas Española: Spain except Catalonia	Lengua Gestual Portuguesa: Portugal
Lingua Italiana dei Segni (LIS): Italy	Lengua de Sinais Brasileira: Brazil
Lugha ya Alama Tanzania (Tanzania Sign Language): Tanzania	Lughat al-Isharatal-Lubnaniya: Lebanon
Nederlandse Gebarentaal: Netherlands	New Zealand Sign Language (NZSL): New Zealand
Nihon Shuwa (Japanese Sign Language): Japan	Norsk Tegnsprak: Norway
Russian Sign Language: Central part of Russia	South Korean Sign Language: South Korea
Svenska Teckenspraket: Sweden	Taiwanese Sign Language (Ziran Shouyu): Taiwan

Thai Sign Language: Thailand	Türk İşaret Dili: Turkey
Ugandan Sign Language: Uganda	Vlaamse Gebarentaal: Flanders, Belgium

ⁱ This is not to say that more reflex-like behaviors, like hand preferences, cannot be culturally overwritten. Someone who is left-handed can be trained to use her/his right hand. This, however, is not an easy task and requires active instructions and often several years of training (sometimes even using forceful practices such as tying of the undesired hand). For an overview, see Porac & Lee Berdel Martin (2007).

ⁱⁱ For example, the informal word for mother in Modern Greek is *manna*, in Latin it is *mamma*, in French it is *maman*, in Turkish it is *ana*, in Omani Arabic it is *mamab*, in Chinese it is *ma(ma)*, in Tibetan *ama*, in Kongo *mama*, in Koro *ma*, in Sitapli *ma*, in Murrumbidgee *mamma*, just to name a few (cf. Murdock, 1959; Jakobson, 1962; Ingram, 1991).

ⁱⁱⁱ Jakobson argues that the first sounds to be produced are usually the labial consonants [m] or [n]. These consonants are then combined in babbling with the most easily produced vowels, i.e., a schwa or *a*-like sounds. The results are syllable sequences similar to *mama*—which are unsurprisingly used, or interpreted by adults as being used, to refer to the most typically important entity in a child's life, i.e., to the mother.

^{iv} Note that if a sign language has a headshake, it is used as part of a language, that is, its timing is highly regularized. This means that the on- and offsets of the headshakes are constrained by the language's grammar (e.g., Baker-Shenk, 1983; Emmorey, 1999; Wilbur, 2003). This is not true to the same extent for gestures used by non-signers (which does not mean that gestures and speech are not temporarily coordinated, cf. Wagner, Malisz, Kopp, 2014). So speech-accompanying headshakes do not have to be obligatorily present simultaneously with specific words/phrases and they are not so well aligned (e.g., Kendon, 2002).

^v Bulgarian Sign Language, for example, seems to be a manual-dominant sign language, i.e., negation is expressed mainly via manual signs (cf. Bulgarian Ministry of Education and Science, 2017). In some cases, negative meanings, however, seem to be accompanied by lateral head movements. This is at least suggested by the dictionary available at spreadthesign.com (see, for example, the adverb NOTHING or the negative existential verb NOT-EXISTING). A clearer case is Albanian Sign Language where negative headshakes are, according to my own observations, present.

^{vi} Note that the alignment of head movements and speech, i.e., the on- and offsets of the gestures, are not part of the grammatical system as in sign languages. Thus, the sentence would also be well-formed without head movements or, for example, with the backward head toss before the beginning of the sentence (see also Harrison 2009; 2014, Andrén 2014).

^{vii} Note that some of the countries shown in Figure 5 were listed as countries in which a negative headshake is used in Section 3.2.1 (e.g., India). This may simply mean that there are different head gestures for negation (maybe different types of negation are expressed using different head movements).

^{viii} Interpreting play-soliciting headshakes as being negative (to indicate that the behavior to follow is not to be taken seriously) is probably too interpretative. It is, however, worth noting that headshakes before game routines were also observed in human toddlers (Masur, 1980; Kettner & Carpendale, 2013).

^{ix} Previous studies reporting headshakes in African great apes have mainly found that they are used to solicit play in bonobos, chimpanzees, and gorillas (van Hooff, 1973; Tanner et al., 2006; Pika, 2007, Luef & Liebal, 2012). This may be very interpretative, but this could be a gesture signaling that the action to

follow after the headshake is not meant to be serious, i.e., that even the play-soliciting headshake involves some sort of negation. Interestingly, the same behavior was observed in human toddlers: they shake their heads in game routines before they begin to use it in negative contexts (Masur, 1980; Kettner & Carpendale, 2013). It is worth noting that headshakes in bonobos may serve different functions, but this gesture is used more often in preventative contexts than in others (Pinfield, 2013).