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Abstract

Ray Jackendoff (2007) claims that most work on consciousness deals "almost exclusively with visual experience" and suggests to focus more on linguistic awareness. Jackendoff proposes that phonological ability – to divide utterances into words and syllables – is at the core of linguistic consciousness. This account can be supplemented by empirical research on language acquisition. Focusing on the step-by-step emergence of linguistic consciousness in infancy can offer new and potentially fruitful angles for investigating states of consciousness. In addition computational models of word segmentation and possible implications for linguistic consciousness are discussed.

1. Introduction

David Chalmers claims "Consciousness poses the most baffling problems in the science of the mind" (Chalmers, 2010, p. 3). The term 'consciousness' covers a range of phenomena, many of which, according to Chalmers, are easy problems (e.g., the ability to discriminate, categorize and react to stimuli, to report mental states, to focus attention, control behaviour etc.). 'Easy' does not imply that it is easy to uncover cognitive mechanisms underwriting these phenomena nor that a complete account of these mechanisms is on the horizon. Rather, it is assumed that, at least in principle, it is possible to solve the easy problems using the methods of cognitive science and neuroscience. Chalmers claims that once all questions regarding the easy problems are answered there will still be some phenomena left unaccounted for. These are the phenomena of subjective experience and they constitute the hard problem of consciousness. Philosophical thought experiments involving creatures real or imagined (e.g., Nagel (1974), Jackson's (1982) Chalmers (2002) are supposed to show that the 'what it is like' aspect of experience is inexplicable by the methods of neuroscience. Not everyone agrees with Chalmers that the hard problem may remain unsolvable by the cognitive sciences (e.g. Dennett (1991), van Gulick, (1993), McDermott, (2001), Carruthers & Schier (2014)). But many remain convinced that methods that work well for the easy problems may not be equally successful for addressing the problem Chalmers defines as follows: "an organisms is conscious if there is something it is like to be that organism, and a mental state is conscious if there is something it is like to be in that state" (Chalmers, 2010, p. 5).

Attempts to frame and to solve the hard problem have traditionally focused on sense experience in general and visual experience in particular. Here I shall focus on the emergence of linguistic consciousness during early language acquisition and suggest that doing so might illuminate 'what it is like to have linguistic experiences' and thus shed some light on the hard problem. I critically engage with Jackendoff's (2007) account and show how this account can be supplemented by empirical research on language acquisition.

2. Jackendoff 's account of linguistic consciousness

Many consciousness researchers share the position described by Zlatev here: "Language seems to be irrelevant for addressing the 'hard problem', unless one adopts a rather extreme position that it is language alone that in one way or another brings about the (illusion) of having qualitative experience" (Zlatev, 2008, 6). It may seem obvious that language has a distinctive function. If this is the case linguistic consciousness would fall under what Chalmers (2002, 2010) calls the easy problem of consciousness. However, Jackendoff (2007) suggested that linguistic consciousness may not reside in meaning but in phonology. Potentially, this proposal could provide a link between the easy and hard problems of consciousness.

According to Jackendoff the majority of consciousness researchers hold that the search for 'neural correlates' of consciousness is an important area of research because they believe that consciousness is "an emergent property of brains that are undergoing certain sorts of activity" (Jackendoff, 2007, 77). However, Jackendoff argues that in most contemporary discussions we find "little description of how experience is actually structured – of how qualia are organized into the conscious field (Ibid., 79). Jackendoff claims that consciousness research focuses (almost) exclusively on vision. "But vision alone is perhaps too limited for an understanding of consciousness that cuts across modalities" (Ibid., 80). He suggests that considering aspects of linguistic consciousness will be illuminating.

The creative use of language presupposes a conscious state of mind and language allows reporting on the subjective experiences related to consciousness. Linguistic structure has three distinct components: phonologic, syntactic and semantic/conceptual structure. According to Jackendoff phonological structure underwrites linguistic consciousness: "When one is experiencing language, the forms of awareness -the qualia- most closely mirror phonological structure" (Ibid., 81). When experiencing language one is first aware of the sounds one perceives. It is not necessary to understand an utterance to become consciously aware of the fact that what one listens to is language (as opposed to 'unspecified noise'). When overhearing a conversation of foreigners one is aware that one listens to language without knowing what the conversation is about. On the other hand, tip of the tongue phenomena show that having meaning without phonological structure does not lead to linguistic awareness. Thus, "phonology is necessary and sufficient for the presence of linguistic qualia, and meaning is neither necessary nor sufficient" (Ibid., 82).

Jackendoff argues that conscious thought can have linguistic (phonology, words, inner speech) or non-linguistic (pictures, music) imagery. Only linguistic imagery can encode quantification, reference to absent objects, abstract concepts, etc. One becomes aware of one's thoughts through the associated phonological qualia or phonological images. Given that deaf people who use sign language do not experience phonological but visual images of hand movements Jackendoff suggests, "the form of thought itself is always unconscious" (Ibid.83). One only becomes conscious of thoughts "through the awareness of phonological structure associated with thoughts" (Ibid. 84) and Jackendoff claims that phonological structure reveals the content of these thoughts.

On Jackendoff's account phonological structure and abstract valuation features, which are bound to the structure of the linguistic percept, are essential for linguistic consciousness. The combination of phonological structure and valuation features affects attention and enhances the power of thought. The valuation dimension accounts for how the linguistic experience is related to the subject: is she the sender or receiver of linguistic signals, are the signals familiar or not, do they have affective content, are they meaningful, etc. It also provides a possible window in the 'what it is like' aspect of linguistic consciousness. Especially one of these valuation features, the external and self-initiated dimension plays an important role in the earliest stages of linguistic consciousness, during the process if language acquisition. Therefore this dimension could be directly relevant to addressing the hard problem.

Jackendoff distinguishes between linguistic percepts (+external) and linguistic images, (-external), and between self initiated and non-self initiated experiences. Hearing one's own voice while speaking is a +external, + self initiated experience. In complex situations (e.g. having a conversation with several people) one can experience several valuations simultaneously. This means "valuations are not characteristics of one's experience as a whole…they are attached to particular percepts and images" (p. 87). Jackendoff argues that these kinds of valuations cut across different sensory modalities. For example, in vision it is possible to distinguish between the perception of a blue square and the imagining of a blue square. The qualia of blue squareness would be categorized as +external/-self initiated and –external/+self initiated respectively. In acoustic perception and proprioception similar distinctions apply, suggesting that linguistic consciousness is based on similar neural correlates as other forms of consciousness. An account of consciousness that cuts across modalities certainly is attractive.

It might be possible to expand on Jackendoff's account to glean insights regarding the hard problem. Jackendoff discusses only cases that rely on subjective experiences of competent speakers who can provide detailed reports about these experiences (e.g. the phonological structure (content features) and the valuation features). Prelinguistic infants could not provide such reports but it does not follow that they have absolutely no conscious experience. It would seem that language acquisition relies on conscious experience and if linguistic consciousness is indeed based on phonological structure, then maybe it can offer insights regarding on how and when consciousness arises during infancy.

3. Language acquisition – from sub-conscious to conscious

Young infants are not able to report about their conscious states, emotions, and motivations. They cannot explain 'what it is like' to be them. However, infants process complex visual stimuli and look preferentially at faces. Initially an infant's visual acuity permits her to see only blobs, but the basic thalamo-cortical circuitry necessary to support simple visual and other conscious percepts is in place. It is likely that the infants has some basic level of unreflective, present-oriented awareness. Many of the neural circuit elements assumed necessary for consciousness are in place already by the third trimester (Koch, 2009).

Infants begin to receive rich information about their native language through exposure to spoken words when they are still *in utero*. Most fetuses begin to respond to sound at 22 to 24 weeks (Hepper & Shahidullah, 1994), and by the time babies are born their basic auditory capabilities are relatively mature (Lasky & Williams, 2005; Saffran et al., 2006). At the normal frequency of the human voice (125-250 Hz) there is little attenuation by the mother's skin, and tissues and the fetus can hear the mother talking (for reviews see Hepper, 2002; Lasky & Williams, 2005) and is affected by exposure to other external sounds (Lecanuet & Schaal, 1996). By the time infants are born they are able to discriminate the voice of their mother from those of other women (DeCasper & Fifer, 1980). Newborns also seem to be familiar with rhythmic properties of their native language. DeCasper & Spence (1986) further demonstrated that newborns showed a preference for passages of prose that their mothers had read aloud during the last six weeks of pregnancy. This preference persisted when the passages were read by another person to the newborn, suggesting that the child recognized not only the voice of the mother but also other acoustic properties of the prose (e.g., DeCasper & Fifer, 1980; Moon & Fifer, 2000). Seemingly infants learn from pre-natal input important details about the phonological structure of the prose read to them.

However, little is known about whether perception at this early stage involves conscious experience. Assuming Jackendoff's account regarding the role of phonological structure for linguistic consciousness, at this early stage the infant might already experience some of the sound-structure she perceives consciously. The fact that young infant prefer the acoustic prose they are familiar with, regardless of the voice reading the prose, might suggest that some of the valuation aspects of linguistic consciousness are not fully developed at this early stage. However, they could already be accessing the 'familiar' valuation aspect described by Jackendoff. If so this could allow some inferences regarding the earliest stages of conscious experience.

It is known that newborns can distinguish between utterances from languages that differ in rhythmic structure based on prenatal exposure to spoken language. Nazzi et al. (1998) showed that French newborns can discriminate between two unknown languages from different rhythmic classes (English versus Japanese), but they cannot discriminate between languages from the same rhythmic class (English versus Dutch). Over the course of several months infants learn to discriminate their own language from other languages in the same rhythmic class (Nazzi et al., 2000). At this early stage semantics or syntax presumably play no role in these discriminations. But phonological structure would be already accessible to the infant. Given that the learning results in increasingly fine-tuned discriminations it is possible that infants become gradually more aware of the relevant phonological features that allow these discriminations.

Between 6 and 12 months of age infants fine-tune the perception of the individual sounds that distinguish between words (or phonemes) in the language to which they are exposed. Werker and Tees (1984) found that 6- to 8-month-old babies distinguish between a wide range of sound differences that signal changes in meaning either in their native language or in non-native languages. And, while some of the 8- to 10-month-old infants were still able to discriminate non-native language contrasts, virtually all 10- to 12-month-old infants discriminated only native language contrasts. It has been suggested that these changes in perception reflect the growing ability of infants to focus their attention only on those acoustic dimensions that are relevant for their native language (Maye et al., 2002). The gradual development of early linguistic perception suggests that infants become increasingly aware of phonological structure. Given that some ability to discriminate important phonological dimensions is already present at birth it seems possible that at least some of these abilities are not dependent on consciousness. More research is needed to confirm if and when these discrimination tasks involve conscious experience. One way to test for consciousness might be to focus on linguistic productions in early childhood.

Before producing the first words of their native language, young infants go through a phase of babbling during which they identify, acquire, and practice the sounds that are common in their language (for a review see Werker & Tees, 1999). The babbling child initially produces a wide range of sounds and later narrows this range to the sounds of her own language. For example the productions of 10-month-old infants exposed to one of four languages (French, English, Cantonese, and Swedish) are already acoustically significantly different and adults can reliably determine which productions were from languages other than their own (Boysson-Bardies & Vihman, 1991). Some researchers have shown that parental feedback can modify the phonological features of babbling (Goldstein & West, 1999; Goldstein et al., 2003) and over time the children succeed in refining their perception so as to categorize sounds along dimensions relevant to their native language.

Children need to master a complex skill set before they can produce linguistic expressions. They need to perceive their own vocalization as their own and monitor how their output matches the input they previously received. This process involves the valuations +self-initiated/+external (for their own voice), -self initiated/+ external (for the perception of someone else's voice), and +self-initiated/-external (for internally 'practicing' vocalizations and creating an inner template). Jackendoff's account offers a framework for testing which component comes 'on-line' when.

At the earliest stages of language acquisition consciousness arises at the level of linguistic phenomenology. At these early stages of language acquisition the child is not aware that what she perceives *is* language. Jackendoff claims that semantics is neither necessary nor sufficient for linguistic consciousness. Possibly, linguistic consciousness arises before the child has access to semantics. At birth the infant is able to perceive some sounds as 'linguistic' sounds and to focus her attention on them. During the first year of life she learns to fine-tune her perception and to produce the sounds of her language. This complex interplay of linguistic and non-linguistic components could provide a framework for testing hypotheses regarding linguistic consciousness.

4. Challenges from computational modeling

Computational models are used to simulate aspects of language acquisition such as speech segmentation. This is a task infants face when they learn to segment the continuous stream of language input into individual words. When infants accomplish this task they might be consciously aware of the input (though presumably not yet of the fact that this input is linguistic). However, computational models are almost certainly not conscious of any features of the linguistic input they receive. Thus if they succeed in the word-segmentation task this may indicate that consciousness is not required for this task.

It has been shown that the stochastic information contained in the linguistic input can assist speech segmentation. Monaghan and Christiansen (2010) used a computational model (PUDDLE) that closely resembles how children learn to break the stream of speech into individual words. They use input that is similar to input received by children. Like young children, PUDDLE builds its lexicon incrementally from the input. This 'strategy' does not require that the model makes multiple, simultaneous decisions about the match between a given utterance and the acquired lexicon. Just like young children, the model is initially unable to perform complex cognitive tasks simultaneously. PUDDLE thus simulates how children can take advantage of features that are readily accessible in child directed speech. The model performs like a child because "the memory resources and computational requirements are minimal" (Monaghan & Christiansen, 2010, 248). PUDDLE focussed especially utterance boundaries and the interspersal of high frequency words in speech (Ibid.). Combining these two cues resulted in very good results in the segmentation task. These results suggest that the stochastic information contained in the input might be sufficiently rich for speech segmentation and that this information might be extracted with relatively simple mechanisms. It further suggests that consciousness is not necessary to succeed in this task.

Other researchers use models that can access simultaneously several cues and combine the information to assist word-segmentation. Blanchard et al. (2010) propose that infants can learn individual words based on frequent occurrence (e.g., their own name, 'mom', frequent function words) and/or language specific phonotactic constraints (stress patterns, allophonetic variation, etc.). Frequently occurring words form the first tiny lexicon, which allows the learner to infer some phonotactic constraints. This information in turn can help to recognize additional words. The combination of these two cues solves one important problem that beginning language learners face: how can they know which phonotactic constraints apply before they know words and vise versa. Thus, "knowledge of familiar words, combined with increasingly refined phonotactic constraints, support and reinforce each other in speech segmentation" (Blanchard et al., 2010, 491).

The model PHOCUS relies on a few basic assumptions about language learning. Beginning with an empty lexicon, it incrementally adds items to the lexicon, based on phonemes that occur together (probabilistic and phonotactic cues). Phonemes that occur within words have high transitional probabilities while phonemes that cross word boundaries have low transitional probabilities (Saffran et al., 1996). In addition to these transitional probabilities, Blanchard et al.'s model could exploit phonotactic cues. Specifically, when the model encountered an unfamiliar word, it could rely on two kinds of phonotactic cues (phoneme combinations and occurrence of at least one syllabic sound per word). The combination of these two simple cues allowed the model to achieve a good performance for English input. Again, this performance was achieved in the absence of consciousness.

Computational models that are not conscious achieve good success-rates in the word-segmentation task. This suggests that consciousness is not necessary for this task. However, it does not suggest that children who succeed in the word segmentation task are *not* (at least on some level) conscious. And, successful word-segmentation is only one of many skills the child needs to master when she acquires language. While computational modeling has successfully simulated several aspects of language acquisition (from word-segmentation to complex syntactical regularities and recursion), so far no model has succeeded in simulating all aspects of language learning. If Jackendoff's overall account is correct, it might be the case that consciousness is required at a much 'earlier' stage of language acquisition than usually assumed, namely long before semantics and syntax are acquired. Maybe future research could test whether valuation features (+/- self-initiated) can be simulated by models and if so whether this leads to improved models. Given that some aspects of language acquisition can be simulated by non-conscious models it is also possible that consciousness does play an integrating role in language acquisition, linking the many different pieces of a very complex puzzle into a coherent whole.

5. Conclusions

Jackendoff's account of linguistic consciousness adds an interesting new perspective to consciousness research that has focused predominantly on visual perception. The proposal that phonology is the locus of linguistic consciousness puts the focus on phenomenology and the proposal of evaluation features grounds linguistic consciousness in personal experience. In combination phonological content and valuation features of linguistic awareness can provide access to the 'what is it like' aspect of linguistic consciousness. In addition, focusing on the step-by-step emergence of linguistic consciousness during infancy can add new and potentially fruitful angles for investigating states of consciousness. During early language acquisition infants might rely increasingly on the conscious experience of the linguistic input and model their output on some of the valuation features suggested by Jackendoff. Computational modeling work has shown that some aspects of language acquisition can be accomplished without consciousness. However, at this time no computational model of all aspects of language acquisition exists. This leaves open the possibility that linguistic consciousness is a necessary pre-condition for language acquisition.

References:

Blanchard, D., J. Heinz, & R. Golinkoff (2010). Modeling the contribution of phonotactic cues to the problem of word segmentation. *Journal of Child Language, 37*, 487–511.

Boysson-Bardies B. & Vihman M. (1991). Adaptation to language: Evidence from babbling and first words in four languages. *Language, 67*, 297–319.

Carruthers, G. & Schier, E. (2014). Why are We Still Being Hornswoggled? Dissolving the Hard Problem of Consciousness. *Topoi*, 1-13.

Chalmers, D. J. (2002). Consciousness and its place in nature. In: D. J. Chalmers (ed.) *Philosophy of Mind: Classical and Contemporary Readings*. (pp. 247 - 272). Oxford: Oxford University Press.

Chalmers, D. J. (2010). *The Character of Consciousness*. Oxford: Oxford University Press.

DeCasper, A. & Fifer, W. (1980). Of human bonding: newborns prefer their mothers' voices. *Science, 208*, 1174–1176.

DeCasper, A. & Spence, M. (1986). Prenatal maternal speech influences on new- borns' perception of speech sounds. *Infant Behaviour and Development, 9*, 133–150.

Dennett, D.C. 1991. *Consciousness Explained.* Boston: Little-Brown.

Goldstein, M., & West, M. (1999). Consistent responses of human mothers to prelinguistic infants: The effect of prelinguistic repertoire size. *Journal of Comparative Psychology, 113*, 52–58.

Goldstein, M. King, A. & West, J. (2003). Social interaction shapes babbling: Testing parallels between birdsong and speech. *Proceedings of the National Academy of Sciences, 100*, 8030–8035.

Hepper, P. & Shabidullah, B. (1994). Development of fetal hearing. *Archives of Disease in Childhood-Fetal Neonatal Edition, 71*, F81–87.

Jackendoff, R. (2007). *Language, Consciousness, Culture*. Cambridge, MA: MIT Press.

Jackson, F. 1982. Epiphenomenal qualia. *Philosophical Quarterly 32*:127-136.

Lasky, R. & Williams, A. (2005). The development of the auditory system from conception to term. *Neoreviews, 6*, 141–152.

Lecanuet, J. & Schaal, B. (1996). Fetal sensory competencies. *European Journal of Obstestrics, Gynecology and Reproductive Biology, 68*, 1–23.

Maye, J., J. Werker & L. Gerken (2002). Infant sensitivity to distributional information can affect phonetic discrimination. *Cognition, 82*, B101–B111.

McDermott, D. (2001). *Mind and Mechanism*. Cambridge, MA: MIT Press.

Monaghan, P. & M. H. Christiansen (2010). Words in puddles of sound: modelling psycholinguistic effects in speech segmentation. *Journal of Child Language, 37*, 545–564.

Moon, C.M. & Fifer, W.P. (2000). The fetus: Evidence of transnatal auditory learning. *Journal of Perinatology, 20*, S37–S44.

Nagel, T. 1974. What is it like to be a bat? *Philosophical Review 83*:435-50.

Nazzi, T., J. Bertoncini, & J. Mehler, (1998). Language discrimination by newborns: toward an understanding of the role of rhythm. *Journal of Experimental Psychology: Human Perception and Performance, 24*, 756–66.

Nazzi, T., P. Jusczyk & E. Johnson (2000). Language discrimination by English-learning 5-month-olds: Effect of rhythm and familiarity. *Journal of Memory and Language, 43*, 1–19.

Saffran, J., R. Aslin, & E. Newport (1996). Statistical learning by 8-month old infants. *Science, 274*, 1926–1928.

Saffran, J., J. Werker & L. Werner (2006). The infant's auditory world: Hearing, speech, and the beginnings of language. In R. Siegler & D. Kuhn (Eds.). *Handbook of Child Development*. (pp. 58–108). New York: Wiley.

Van Gulick, R. 1993. Understanding the phenomenal mind: Are we all just armadillos? In: M. Davies & G. Humphreys (eds.) *Consciousness: Philosophical and Psychological Aspects*. Blackwell.

Werker, J. & Tees, R. (1984). Cross language speech perception: evidence for perceptual reorganization during the first year of life. *Infant Behaviour and Development, 7*, 49–63.

Zlatev, J. (2008). The dialectics of consciousness and language. *Journal of Consciousness Studies , 15* (6), 5-14.