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Language Comprehension and Emotion: Where Are the Interfaces, and Who Cares?

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Abstract and Keywords

When you hear somebody speak, or read a bit of text, you are somehow assigning meaning to an unfolding sequence of signs. Because of the representational and computational complexity involved, this process of language interpretation is considered to be one of the major feats of human cognition. However, you also happen to be just another mammal, and as such, you are biologically predisposed to have emotions, evaluations, and moods (i.e. to feel certain things about your environment). How do these two acts of assigning meaning relate to one another? And what are the implications for neurolinguistics, the endeavor to understand how the brain realizes language use? After examining why emotion is not naturally foregrounded in language processing research, this chapter reviews some basic insights in emotion science, discusses a processing model of affective language comprehension, and explores how the model can contribute to neurolinguistics and other fields.

Keywords: emotion, evaluation, mood, affective language, cognition-emotion interface, referential intentions, social intentions, stance, neurolinguistics

Introduction

WHEN you hear somebody speak, or read a bit of text, you are somehow assigning meaning to an unfolding sequence of signs. Because of the representational and computational complexity involved, this process of language interpretation is considered to be one of the major feats of human cognition. However, you also happen to be just another mammal, and as such, you are biologically predisposed to have emotions, evaluations, and moods (i.e., to *feel* certain things about your environment). How do these two acts of assigning meaning relate to one another? And what are the implications for

neurolinguistics, the endeavor to understand how the brain realizes language use? These are the central questions addressed in this chapter.

Over the last few decades, interest in the role of emotion in cognition has sharply increased, and a substantial part of current cognitive neuroscience research is about how affective factors mesh with cognition. With some delay, this affective turn in research on mind and brain has also reached the language sciences (e.g., Corver, 2014; Jensen, 2014; Majid, 2012; Peräkylä & Sorjonen, 2012; Van Berkum, 2010). In neurolinguistics, for example, an older strand of research on the processing of emotional prosody (e.g., Pell, 1999) is now joined by research on such topics as the impact of emotional state on language comprehension (e.g., Egidi & Carramazza, 2014; Van Berkum, De Goede, Van Alphen, Mulder, & Kerstholt, 2013), the processing of "emotion words and sentences" (e.g., Hoffmann, Mothes-Lasch, Miltner, & Straube, 2015; Ponz, Montant, Liegeois-Chauvel, (p. 737) Silva, Braun, Jacobs, & Ziegler, 2014), and the brain's response to swear words and other morally loaded language (Leuthold, Kunkel, Mackenzie, & Filik, 2015; Van Berkum, Holleman, Nieuwland, Otten, & Murre, 2009).

But what is the status of such research in the language sciences? When discussing such work with students in linguistics programs, the response is often mixed, in a way that may well be indicative of a wider attitude in the field. Many find the topics quite interesting. Emotion is "catchy," and discussing its interface with language sometimes offers a welcome change from such topics as predicate logic, minimalist syntax, or combinatorial symbol processing in the brain. Also, many phenomena are saliently connected to the students' personal lives, from the reduced effectiveness of using a non-native swear word to the painful sting of sarcastic prosody or a hesitant reply. At the same time, these students often feel that research on language and emotion is not really "at the heart of the matter." The reasoning seems to be something like this:

1. Language is a code via which we communicate about *everything*, from muffin recipes to our deepest fears, for a principally infinite number of reasons, and to a principally unlimited number of effects.
2. Psycholinguistics and the associated cognitive neuroscience research endeavor should study the generic mechanisms via which people acquire and use that code.
3. *Other* disciplines, like emotion science or social psychology, should study what happens when people communicate about the specific things they do, and why they choose to do so.
4. Although psycholinguistics is connected to those other disciplines in virtue of people using language for everything, there is nothing about the interface that is really of relevance to the task of understanding the *generic* mechanisms via which people acquire and use language.

The reasoning is intuitively compelling, for muffin recipes, but also for our fears and other emotions. Indeed, if human emotion is just a topic, a cause, or a consequence of particular instances of language use, cleanly separated from the machinery that does the language processing, psycholinguistics can just focus on the processing *regardless of*

emotion. So, is it this simple? In this chapter, I argue that it is not. The processing of language and emotion is intricately intertwined, in ways that psycholinguistics and the associated cognitive neuroscience enterprise cannot afford to ignore.

The analysis begins by examining why emotion is not naturally foregrounded in language processing research. Because many readers will not be familiar with current views on emotion, I subsequently review some basic insights, covering short-lived salient emotions as well as other affective phenomena. After that, I make explicit the various types of representations that people compute as they use language, ask where emotion might kick in, and apply the resulting *Affective Language Comprehension* model to (p. 738) several neurolinguistics studies—this is the heart of the chapter. Finally, I explore how the model can contribute to neurolinguistics and other fields.[1]

A terminological note: just as in emotion science, I will use “emotion” in two different ways in this chapter. The narrow meaning is that of the event-driven short-lived phenomena that immediately come to mind when thinking about emotion: fear, joy, anger, pride, disgust, and so on. More broadly construed, the term “emotion” (or “affect”) covers emotions in this narrow sense, but also other affective phenomena, such as affective evaluations and moods. Definitions of these various phenomena will be given later in the chapter.

The Standard Approach to Language Processing

Attention to emotion in psycholinguistics and the associated cognitive neuroscience research is relatively recent, and current major textbooks and handbooks still reveal a thoroughly “cold,” non-affective perspective on language processing that has characterized the field for decades. The roots of this cold perspective can be found in several important historical developments in the field, each of which led to a particular bias (see van Berkum, 2018, for more extensive discussion).

Technological Systems Focus

Just like other disciplines within, or overlapping with, cognitive psychology, psycholinguistics has been heavily shaped by the technology-driven digital information processing perspective in that larger field. In psycholinguistics, this technology frame has inspired people to ask about such things as how comprehenders decode noisy acoustic signals, store and retrieve lexical representations, recover syntactic structure, derive a proposition, compute reference, update the situation model, and code their own ideas for subsequent transmission—all questions about retrieving, manipulating, and storing information. As might be expected, though, the technology frame did not readily lead to questions about emotions, evaluations, and moods, or the needs of real living organisms that give rise to these affective phenomena.

(p. 739) Code-Cracking Focus

Psycholinguists have always enjoyed the luxury of being able to work from whatever linguists had discovered about the nature of language. But with that luxury also came subject matter biases operating in linguistics itself. Mainstream linguistics in the 1970s–1990s focused on language as a generative coding system, and abstracted away from actual usage. As such, it has inspired a lot of psycholinguistic research on how people crack the linguistic code (cf. all the research on lexical retrieval, syntactic parsing, anaphoric reference, and ambiguity resolution) and how they acquire or lose their code-cracking competence, but it has *not* inspired psycholinguists to study how the code actually gets to *affect* people.

Modularity Focus

Third, even for psycholinguists who did acknowledge the importance of emotion to mental life, nothing of importance seemed to follow for their everyday scientific concerns. After all, was the language system, or at least the most interesting bit of it, not "informationally encapsulated" from the rest of mental life anyway? The idea that language was an independent "module" in the mind (Fodor, 1983) paved the way for thinking about language comprehension as computing what is said and implied *before, and cleanly separate from*, computing the affective significance for the reader or listener.

Uniqueness Focus

As scientists carve up the world between them, it is only natural that people in different disciplines tend to focus on what is unique to "their" chunk of the world. Language is a discrete combinatorial system for very precise reference, unique in the animal kingdom. However, psycholinguistics cannot focus only on the unique. To understand how the system actually works in practice, you also need to look at the parts that may *not* be so unique for Homo sapiens, but are critical just the same—such as memory, or emotion. For example, although the observation that learning principles studied by behaviorists could not easily account for the complexity of linguistic behavior was critical in the development of the language sciences, this observation does *not* imply that as language users, people are free from the standard effects of classic emotional conditioning.

The previously mentioned biases are to a large degree responsible for the dominant, standard perspective on language use in psycho- and neurolinguistics, a perspective one might call the *TCP/IP approach to language use*. In the TCP/IP approach, language users are reduced to computational devices that exchange information via a fixed communication protocol (a human TCP/IP[2]), coding ideas into utterances and transmitting (p. 740) them for subsequent decoding at the other end, with the conversion to or from the code carried out by special language "modems." The research agenda of this approach can be extracted from any recent psycholinguistics textbook or handbook, as well as from programs of major psycho- or neurolinguistics conferences. Most of that agenda is about storing, retrieving, manipulating, and transmitting data, about how

listeners figure out the bits of information that speakers want to pass on to them, and about how speakers figure out what listeners already know, so that fewer bits need to be coded and transferred.

Now, human language *is* a code for communication, and language users *do* need to master that code to be able to profit from the additional precision and expressivity that language provides. Research on the nature of the code, and on how language users acquire, crack, and generate bits of this code, is therefore crucial to understanding the human mind and brain. Having said that, it is clear that the TCP/IP approach cannot be the whole story. Most obviously, language users are *not* dispassionate, immobile information systems representing and exchanging information; they are animals with things at stake, and with situations to cherish or best avoid. They *care* about things. Moreover, they care enough about things to want to use language to inform, manipulate, or deeply connect with other people (cf. Tomasello, 2008). They *do* things with words (Austin, 1962), to each other, and sometimes also to themselves. Emotion is at the heart of all that. Hence, if we really want to understand the neural mechanisms that allow language to be *useful*, we need to ask about emotion.

What Is Emotion? A Primer for Language Researchers

Emotion is what has kept you alive so far—although details may vary, emotion may have saved you from drowning, being run over by a car, losing sight of your primary caretakers in a large crowd, or losing the means to sustain yourself. The affective systems responsible for emotions, evaluations, and moods are at the core of how brains control adaptive behavior in a complex environment (Damasio, 1994; Davidson, 2012; Frijda, 2008; Ledoux, 1996; Panksepp & Biven, 2012; Scherer, 2005)—not just in humans, but in all mammals. Emotion science is a huge area of research, with branches reaching into such disciplines as evolutionary biology, neuroscience, psychology, ethnography, and philosophy (for various broad displays of this vast area, see Barrett, Lewis, & Haviland-Jones, 2016; Davidson, 2012; Nussbaum, 2003; Prinz, 2004; Sander & Scherer, 2009; Wetherell, 2012). There are countless fundamental debates, on such things as what counts as emotion, on whether we have basic emotions, on the relative contribution of biology and culture, and on how emotion relates to cognition (see Barrett et al., 2016, for an extensive overview). Here, I focus on several key ideas and distinctions that have (p. 741) generally proved useful to the field and are important when addressing the relation between emotion and language.

The starting point is a working definition of emotion that is suitable for current purposes:

> An emotion is a package of relatively reflex-like synchronized motivational, physiological, cognitive, and behavioral changes, triggered by the appraisal of an external or internal stimulus event as relevant to the interests (concerns, needs, values) of the organism, and aimed at generating a prioritized functional response

> to that stimulus event. The changes involved need not emerge in consciousness, but to the extent that they do, they give rise to feeling.

This definition (which largely follows Scherer, 2005, but also incorporates aspects of other proposals, notably Adolphs, 2017; Damasio, 2010; Frijda, 2008; Lazarus, 1991; Panksepp & Biven, 2012), highlights several core properties of emotion that I will unpack in the following.

(1) Emotions are triggered by the appraisal of something as relevant to our concerns.

Emotions emerge when something about a stimulus is appraised as relevant to one's interests, either positively (such as when you win a contest, or see your child do well in a school performance), or negatively (such as when you are insulted, find a huge spider in the crib of your two-month-old baby, or drop your smartphone on the floor). An emotion is referential (i.e., *about* something). What it is about might be "out there," as in all the preceding examples, or inside your head, as when you remember or imagine any of the preceding, or mentally represent these scenarios in response to language; that is, although examples in the emotion literature are often about concrete events, objects, or situations in our environment, *thoughts* (consciously as well as unconsciously entertained) can just as easily trigger emotion. Following Damasio (2010), I will use the term *emotionally competent stimulus*, or ECS, to cover all of this. Appraisal can to some extent be deliberate (i.e., under slow conscious control), but in line with what emotion is supposed to do for us, it is usually fast, automatic, and unconscious (Adolphs, 2017; Frijda, 2008; Prinz, 2004; Scherer, 2005; Zajonc, 1980)—as every psychotherapist or coach will know, people often don't know what aspect of a situation, person, or event exactly triggered their emotion, or for what reason. Also, as illustrated by research on olfactory and visual perception (e.g., Li, Moallem, Paller, & Gottfried, 2007; Tamietto, Castelli, Vighetti, Perozzo, Geminiani, Weiskrantz, & de Gelder, 2009), people can respond affectively without having *consciously perceived* the stimulus at all.

(2) Emotions involve a "package" of relatively automatic, short-lived, synchronized changes in multiple systems.

Emotion is not just about appraising something as relevant to your interests, but also about *doing* something about it. For example, when something makes you angry, your heart beats faster, you sweat a little more, and stress hormones are released, as your body is preparing itself for "combat." You will momentarily feel a (p. 742) strong urge to act, and perhaps you will strike or yell at something, or someone. Your face will have an angry expression. Attentional focus will briefly narrow, such that you are no longer able to attend to other things in the environment. And finally, you may become very aware of all of this, giving you the typical "feel" of anger. These specific changes make up the average "package" for anger. Qualitatively different emotions, such as anger and fear, have different action packages, with some shared ingredients (e.g., both increase sweating), but also some major differences (e.g., in contrast to anger, fear increases the probability of retreat and avoidance). Specific instances of anger may also differ somewhat in their exact "mix" of ingredients, and some mixes will be more prototypical

than others. The key observation, however, is that emotions involve relatively automatic, short-lived, and synchronized changes along several different dimensions: (a) *motivational changes* or *action tendencies*, the readiness to engage in, or disengage from, particular behavior; (b) *physiological changes* that prepare the body for action or impact; (c) *cognitive changes*, such as increased attention and better memorization; and (d) *behavioral changes*, involving approach or avoidance, as well as more specific actions such as smiling, frowning, shouting, crying, changing posture, stroking, exploring, or playing.

(3) Emotions briefly take control.

Emotion emerges when something is deemed sufficiently important to relatively automatically engage multiple systems simultaneously, to have "all hands on deck." It is also about doing something *now*. Frijda (2008, p. 72) characterizes emotion as "event- or object-instigated states of action readiness with control precedence"; that is, you really have an urge to do something *right now*: strike out or yell at the intruder, or write that email *now*. And that makes sense; after all, emotions are designed to watch over your interests, directly or indirectly rooted in core biological values shaped by evolution. Although culturally conditioned and other personal life experiences construct additional layers of emotional complexity that are unique to humans (Barrett, 2014), emotion is first and foremost about "biological homeostasis," about regulating life within survival-promoting and agreeable ranges (Damasio, 2010; Panksepp & Biven, 2012). Emotions are bits of rapid biological intelligence that have proved useful in the past—reflex-like solutions to recurring problems in the life of the species (and its ancestors), briefly taking control, but also open to various forms of regulation (Adolphs, 2017).

(4) Emotions are not necessarily conscious.

A crucial insight in emotion science is that emotion doesn't need to be conscious (Damasio, 2010; Frijda, 2008; Panksepp & Biven, 2012; Scherer, 2005); that is, one can have all of the ingredients (a) to (d) mentioned earlier without actually being aware of them (i.e., of *feeling* them). This may be counterintuitive, because in daily life we use "emotion" and "feeling" interchangeably. When *strong* emotions are elicited, we will certainly "feel" them. But what holds for other aspects of brain function also holds for emotion: most of the computations are done without us being aware of the process and its results (Adolphs, 2017); that is, weak emotions may unfold and affect our thoughts and behavior without *any* subjective awareness. If this is hard to imagine, think about moments in life when you suddenly became aware that you have been avoiding someone, or something, or that in particular (p. 743) situations, your neck muscles tend to tighten up. Or about the effort that is sometimes needed to make the relevant appraisals involved in your emotional life explicit, so that you can reflect upon them.

(5) Emotions have ancient triggers but can hook up to new ones via learning.

For psycholinguists, a particularly critical observation is that there seem to be no limits on the types of stimuli that can become emotionally competent. For a limited class of biologically significant stimuli (e.g., pain, an unexpected loud noise, signs of decay, being

bodily restricted, the anticipation of sex or food, being stroked or otherwise cared for, the loss of social bonds, a helpless baby, and the basic emotional displays of conspecifics, such as smiles and frowns, aggression, or playful movement; Panksepp & Biven, 2012), that competence is simply hardwired into your brain. Via "emotional conditioning," however, an *infinite* number of other stimuli can also become emotionally competent (De Houwer, Thomas, & Baeyens, 2001; Hofman, De Houwer, Perugini, Baeyens, & Crombez, 2010; Ledoux, 1996; Panksepp & Biven, 2012), as generic categories, or as specific tokens. The amygdalae are believed to be crucial to such emotional conditioning, and they are capable of forging emotional associations without any awareness or episodic recollection of the coupling (Janak & Tye; 2015; Ledoux, 1996; Phelps, 2006). However, depending on the specific emotion involved, many other emotion-relevant neural systems can also be involved, as generators of the affective brain state (i.e., the *unconditioned response*, or UCR) that is now associatively connected with something new (the *conditioned stimulus*, or CS), but also by realizing brain states that enhance the formation of new memory (e.g., via arousal; Panksepp & Biven, 2012).

Crucially , as an unavoidable consequence of the generic mechanisms of associative learning in the brain, the *non-natural signs* studied by semiotics and linguistics (e.g., a brand logo, a word, a particular linguistic construction) can also become emotionally competent (e.g., Fritsch & Kuchinke, 2013; Hofmann et al., 2010; Jaanus, Defares, & Zwaan, 1990; Kuchinke, Fritsch, & Müller, 2015; Keuper, Zwanzger, Nordt, Eden, Laeger, Zwitserlood, Kissler, Junghöfer, & Dobel, 2014; Ortigue, Michel, Murray, Mohr, Carbonnel, & Landis, 2004; Pülvermüller, 2012; Schacht, Adler, Chen, Guo, & Sommer, 2012; Silva, Montant, Ponz, & Ziegler, 2012). Such conditioning occurs automatically whenever a particular sign is sufficiently reliably (or sufficiently strongly) paired with affective responses, either in *actual* experience, or when such experience is sufficiently imagined (as when we read a novel). Of course, the emotional conditioning process must always bootstrap from *something*. But as the advertisement industry shows, this is not hard at all: companies effectively associate their car, coffee, and ice cream brand names or logos with positive emotions, simply via systematically pairing the initially neutral stimulus with something that already *is* a highly competent ECS (e.g., an attractive man or woman, a scene with friendly people having fun). Although emotional conditioning can lead to the transfer of strong and very salient emotions (as with the fear conditioning that underlies PTSD or phobia), it usually affects us in much subtler ways, via sometimes fully unconscious affective evaluations and the associated preferences (see Hofmann et al., 2010, for a meta-analysis with verbal and nonverbal stimuli). In all, (p. 744) emotions are sticky little things, value-relevant response packages that can attach themselves to *anything* without you noticing, and with the appraisal that is needed to elicit them consisting of little more than the automatic retrieval of an acquired association from long-term memory.

(6) Affective evaluation is low-intensity emotion.

In a wide variety of fields, ranging from social psychology (e.g., Zajonc, 1980) to the neuroscience of visual perception (e.g., Barrett & Bar, 2009), research has shown that we

hardly ever see things in a neutral way: affective evaluation is part and parcel of how we perceive the world. In the words of Zajonc (1980, p. 154):

> One cannot be introduced to a person without experiencing some immediate feeling of attraction or repulsion and without gauging such feelings on the part of the other. [. . .] Nor is the presence of affect confined to social perception. [. . .] We do not just see "a house": we see "a handsome house," "an ugly house," or "a pretentious house." We do not just read an article on attitude change, on cognitive dissonance, or on herbicides. We read an "exciting" article on attitude change, an "important" article on cognitive dissonance, or a "trivial" article on herbicides. And the same goes for a sunset, a lightning flash, a flower, a dimple, a hangnail, a cockroach, the taste of quinine, Saumur, the color of earth in Umbria, the sound of traffic on 42nd Street, and equally for the sound of a 1,000-Hz tone and the sight of the letter Q.

Such automatic affective evaluations of the world around us build on the same affective systems that generate salient emotions like anger, fear, disgust, pride, or joy. With evaluation, however, the intensity of the emotion is so low that the response feels like a quality of the stimulus ("an ugly house"), rather than like a particular state that we are in ("that house made me feel disgusted"; see Barrett & Bar, 2009, for this distinction). Importantly, just like more salient emotions, evaluations have an action component (emphasized by the term "preference"): a more positive evaluation is associated with approach motivation, with—consciously or unconsciously—*preferring* the evaluated item over something else. Furthermore, these affective evaluations are by no means necessarily "*post*-perceptual," or "*post*-conceptual" (i.e., are not necessary generated only *after* something has been fully identified or conceptualized in cognitive terms). In vision, for example, affect can be part of the *initial* response to low-resolution, "coarse" aspects of an image, either because of some evolutionary hardwiring (e.g., jagged contours, or the outline of what might be a snake), or because of the associative conditioning brought about by real or vicarious experience (e.g., the contours of a gun; see Barrett & Bar, 2009). Echoing the classic psychological notion of subjective perception, there is growing evidence in cognitive neuroscience that what something *is* can often not be meaningfully separated from what it means *to me*—perceptions are not objective, and affect can be an intrinsic part of perception (Barrett & Bar, 2009; Gantman & Van Bavel, 2015; Lebrecht, Bar, Barrett, & Tarr, 2012).

(7) Mood.

Mood differs from short-lived emotion in that it involves a relatively slow-changing affective background state that is not really *about* something (i.e., is not (p. 745) "referential"; Forgas, 1995; Scherer, 2005). Also, whereas short-lived emotions play their role via unique prioritized action packages, mood is believed to play a functional role in signaling the amount of resources available for exploration of the environment (Zadra & Clore, 2011), and/or for signaling that the current course of action is working out well (Clore & Huntsinger, 2007). The effects of this show up in differential patterns of action *and* cognition. For example, in a bad mood we are not only less inclined to climb a steep

hill, but also inclined to overestimate the steepness of that hill (Zadra & Clore, 2011). Furthermore, a bad mood narrows the spotlight of visual attention (Rowe, Hirsch, & Anderson, 2007), and reduces such things as the width of associative memory retrieval (Rowe et al., 2007), the use of scripts in episodic memory retrieval (Bless, Schwarz, Clore, Golisano, Rabe, & Wölk, 1996), or the sensitivity to social stereotypes in person judgment (Park & Banaji, 2000). In all, mood tunes cognitive processing in a variety of interesting ways, again without us being aware of it.

(8) Emotions, evaluations, and moods recruit special neural circuity.

Emotion is important enough to warrant biologically evolved special neural and neuro-endocrine machinery, partially or fully emotion-dedicated systems that we share with many other animals (Adolphs, 2017; Panksepp & Biven, 2012; see also various chapters in Barrett et al., 2016, for review). Many of those are subcortical structures (e.g., amygdala, hypothalamus, nucleus accumbens, ventral tegmental area (VTA), periaqueductal grey (PAG)), but various regions of the neocortex (e.g., insula, anterior cingulate cortex (ACC), ventromedial prefrontal cortex (vmPFC)) are also involved. Some of the emotion-relevant neural structures are responsible for generating the physiological component of emotion (e.g., the hypothalamus, which controls much of the body's internal milieu via direct neural innervation, as well as a wide array of hormones released by the pituitary gland). Others play a crucial role in supporting the *subjective feeling* of an emotion, such as the anterior insula, which provides a map of visceral sensation (Craig, 2009), or the PAG, which has been argued to underlie aspects of subjective core affect (Panksepp & Biven, 2012; see also Satpute, Wager, Cohen-Adad, Bianciardi, Choi, Buhle, Wald, & Barrett, 2013). The degree to which *specific* emotions have their own dedicated, non-overlapping bits of the brain is heavily debated, and the most plausible model is one in which emotionally critical structures like the amygdala play a—potentially different—role in different emotions as a function of being recruited in a different wider network (Adolphs 2017; Hamann, 2012; Kragel & LaBar, 2016; Pessoa, 2017). In any case, careful cross-species studies of systems involved in fear, rage, care, or reward (reviewed in Panksepp & Biven, 2012) unequivocally show that nature did not leave emotion entirely up to chance.

(9) The utility of emotion.

Our emotional life covers a vast range of phenomena, intense and subtle, consciously experienced or unconsciously nudging us, experienced as strong emotion "in us," or leading us to simply and sometimes imperceptibly "prefer" particular things—people, objects, signs, ideas, actions—over others, or to refrain from exploration at all. The point of all this, of course, is that our emotional life controls our behavior. Emotions and evaluations are "motive states" (Frijda, 2008, 2013), urging or (p. 746) nudging us to approach or avoid, prefer, attend to, explore, grab, attack, submit to, care for, play with, or protect oneself from entities or events out there in the world, all because of how those entities or events relate to our interests (Damasio, 1994; Frijda, 2008; Panksepp & Biven, 2012). And emotion does so right here, in *your* life. Emotional control is *not* just something that was vital when humans were hunter-gatherers, and obsolete in this age of food counters, gadgets, and the Internet. The motive states that are part and parcel of

emotions, evaluations, and moods control much of your everyday behavior, from the supermarket you go to and the things you buy there, to the people you seek out to chat and perhaps live with. They also determine whether you read on or whether you cast this chapter aside, and whether you mentally explore certain ideas or not. Emotions, evaluations, and moods need not be very strong to exert this control, and we may not be aware of how they tug at us at all; our decisions to pursue some things over others can be controlled by very subtle valence differences (cf. micro-valence; Lebrecht et al., 2012). But they do guide us in our actions.

Those actions can be overt behavior, but also *acts of thinking*. For example, emotions and evaluations play a crucial role in what we often experience as "rational" reasoning and decision-making (e.g., Bechara, 2009; Damasio, 1994; Gigerenzer, 2007; Phelps, Lempert, & Sokol-Hessner, 2014), when people are, for example, considering consumer products or medical treatments (Kahneman, 2011), or thinking about a morally responsible course of action (Greene, 2014; Haidt, 2012). Emotions and evaluations also influence attention (e.g., Harmon-Jones, Gable, & Price, 2012; Vuilleumier & Huang, 2009), memory encoding and retrieval (e.g., Adolphs, Denburg, & Tranel, 2001), and reasoning and decision-making (e.g., Damasio, 1994), and the specific beliefs that people are inclined to commit themselves to (Frijda, 2008) (for reviews, see Dolcos & Denkova, 2014; Dolcos, Iordan, & Dolcos, 2011; Pessoa, 2008, 2010; Phelps, 2006; Phelps et al., 2014; Zadra & Clore, 2011). Most of this affective control over our thinking occurs without our being aware of it.

Just like in other mammals, our affective system is thus key to the control of adaptive behavior in a complex environment (Panksepp & Biven, 2012). And just like other mammals, such control is greatly enhanced by our capability for associative and other forms of learning. What is special about us, Homo sapiens, is that our brain is capable of constructing a much wider and more diverse range of representations of that environment, as well as of ourselves, such that there is much more to have emotions *about* and evaluations *of*, and such that we can influence our and other people's behavior in much more sophisticated ways. At the pinnacle of that sophistication is our talent for language, and the inferential communication skills upon which that talent rests.

The Affective Language Comprehension Model

So, how does the affective control system that we have just examined mesh with language processing? In the context of this *Handbook*, it may seem obvious to address this (p. 747) question by (a) delineating the sets of neural structures involved in emotion and language processing, as well as the structural and functional connectivity between those sets; and/or (b) simply reviewing all the empirical cognitive neuroscience research (with electroencephalography [EEG], magnetoencephalography [MEG], functional magnetic resonance imaging [fMRI], etc.) on specific interactions between language and emotion and inductively infer generic insights from that. However, these are *not* the approaches taken here. As for the first, the set of neural structures involved in emotion is very large,

and there is much debate on the precise functional characterization of those structures, as well as increasing awareness of the importance of dynamically configured networks and the different roles that a particular node can play as a function of the network it is in (Hamann, 2012; Pessoa, 2017). The same holds for language processing (see the many chapters in this *Handbook*). This makes the hypothesis space for a bottom-up connectivity-based approach rather large (but see Koelsch, Jacobs, Menninghaus, Liebal, Klann-Delius, von Scheve, & Gebauer, 2015).

As for the second approach, reviews of concrete cognitive neuroscience experiments that explore the interface between language and emotion are extremely useful (e.g., Citron, 2012). At the same time, I think they should be complemented by a theoretical perspective. As reflected in rather loosely used expressions like "emotion sentences," much of the cognitive neuroscience research on language and emotion operates with a relatively crude, non-articulated model of language processing—usually one that focuses on context-free lexical or sentence meaning, at the expense of context-dependent pragmatic levels of interpretation. If we are to make progress on how emotion and language processing interact, however, we must begin by honoring the *real* complexity of language processing. We know from pragmatics and psycholinguistics that language comprehension is a highly complex business that extends beyond the single utterance, involves several layers of interpretation, and is heavily context-dependent. We also know that language is just one of many simultaneous "channels" or sign systems via which we communicate, and that as we speak or write, such things as a flat voice, raising an eyebrow, a well-chosen emoji, or slightly turning away can make all the difference. What would be helpful is a wide-scope *functional* ("algorithm-level"; Marr, 1982) model that pulls these various things together, and that systematically explores the functional interfaces with emotion. A model like that can support researchers in orienting themselves, and in asking more refined questions about how language and emotion interface in the brain (see also Willems, 2011, for the importance of a top-down approach in cognitive neuroscience research).

In the remainder of this chapter, I describe and discuss such a blueprint for language comprehension: the *Affective Language Comprehension*, or ALC, model. The model was developed in a simple, two-step fashion, by first making explicit the various types of representations that listeners or readers compute as they process language, and by subsequently asking where emotion might kick in. The original description of the model (van Berkum, 2018) features an analysis of a verbal insult with a swear word, and provides a related ALC-based analysis of the concept of word valence. Here, I expand the scope of the model by showing that is also applies to several apparently much less "emotional" **(p. 748)** examples (see the following section), and by subsequently illustrating the utility of the model in interpreting the results of a few example cognitive neuroscience studies.

A Blueprint for Affective Language Comprehension

So what types of representations do language users compute when they comprehend a spoken or written utterance? Drawing upon central ideas in psycholinguistics and pragmatics (e.g., Clark, 1996; Enfield, 2013; Jackendoff, 2007; Kintsch, 1998; Levinson, 2006; Trueswell & Tanenhaus, 2005; Tomasello, 2008; Zwaan, 1999), as well as on what we know about representation and processing from cognitive science and neuroscience, Figure 29.1 represents a reasonable claim about the types of representation being computed and the subprocesses involved in computing them.

To see the model at work, I will discuss three different example utterances throughout: (1) a relative uttering, "Even *John* thinks euthanasia is acceptable in this case"; (2) a spouse uttering, "We've run out of dog food"; and (3) a teacher uttering, "The number 7 is *also* a prime number." The question I ask is: What impact can these communicative moves have on addressee Y at that point in the exchange? In particular, what representations might addressee Y compute, consciously as well as unconsciously, and which of those representations can in principle be emotionally competent stimuli (ECSs) for this addressee?

The Input: Multimodal, Composite Signs

In face-to-face conversation, conversational moves are always implemented as multi-modal, composite signs, which include not just words arranged in a certain way, but a wide variety of nonverbal signs as well (Clark, 1996; Enfield, 2013; Goodwin, Cekaite, & Goodwin, 2012; Jensen, 2014). And in writing, people try to replace some of those signs (e.g., emoji, exclamation marks). As for our examples, speaker X will inevitably utter these sentences in a specific manner, such as with an annoyed, a pleading, or a relaxed and patient voice, and with a certain expression and posture—nonverbal aspects that, as will be seen in the following, are critical to interpretation.

Recognizing/Parsing the Signs Presented by the Speaker

The conventionalized ingredients of the composite sign will cue representations in long-term memory (LTM), traces of stable practices of sign use tracked by an ever-learning brain. For example, words like "euthanasia," "dog," or "number" will cue (retrieve, activate) whatever stable memory traces addressee Y has stored for those signs in the mental lexicon, including their phonological and/or orthographic form properties, their syntactic properties, and their conceptual properties, all of which will be brought to bear on how the sentence will be parsed (Jackendoff, 2007). Specific *constellations* of words, such as idiomatic expressions, or other stable constructions (Fillmore, Kay, & O'Connor, 1988; Lakoff, 1987), will likewise cue such representations in LTM (Jackendoff, 2007). And particular gestures, facial expressions, or emoji will do so as well. (p. 749)

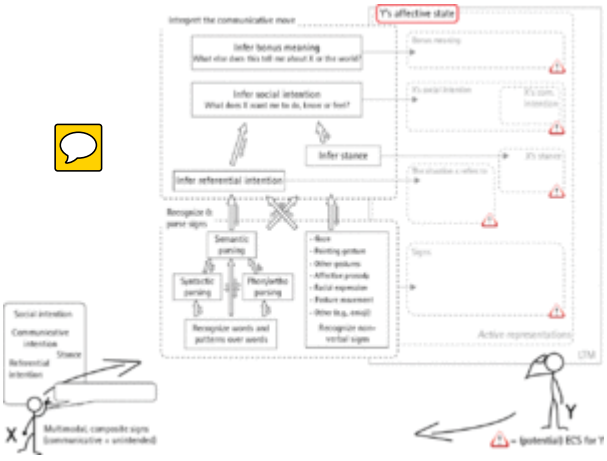

Figure 29.1. The *affective language comprehension* (ALC) model. Mental processes and the associated retrieved or computed representations are expanded for addressee Y only. Y's computational processes draw upon (and add to) long-term memory traces, and involve currently active dynamic representations that reflect what is currently retrieved from LTM, composed from elements thereof, and/or inferred from context, in response to the current communicative move. Y's active representations can be conscious or unconscious. Bonus meaning can be inferred from (or cued by) all other active dynamic representations, and Y's current affective state (e.g., mood) can influence all ongoing computational processes (arrows for these aspects not shown). The basic processing cascade is upward and incremental, starting from the signs, but small downward or sideways arrows between component processes indicate top-down or sideways prediction or constraint satisfaction. Within each of the delineated representational types, one or more ECSs can trigger an emotional processing cascade that affects Y's motivational inclinations, physiology, cognitive processing, and actual behavior, plus possibly Y's conscious feeling.

Abbreviations: ECS = emotionally competent stimulus; LTM = long-term memory; Phon/ortho parsing = phonological/orthographic parsing; X's com. intention = X's communicative intention.

(p. 750) Importantly, individual words and other "atomic" signs can *themselves* be ECSs, (i.e., trigger a bit of emotion *independent of the wider utterance and its pragmatic implications*). Models of how the brain represents word meaning have been shifting away from amodal feature lists and directed graphs, toward a more modal view in which lexical meaning is grounded in actual experience (e.g., Barsalou, 2008; Pülvermüller, 2012). Some psycho- and neurolinguists have begun to explore this for words that *refer* to emotions or evaluations and the associated behavior (e.g., "smile," "annoying"; Foroni & Semin, 2009; Künecke, Sommer, Schacht, & Palazova, 2015; 't Hart, Struiksma, Van Boxtel, & Van Berkum, 2018a, 2018b). But given what we know about associative learning in the brain, and of emotional conditioning as a special case of that (see previous discussion in this chapter), the potential for grounding lexical meaning in emotion is much wider than that (for evidence, see, e.g., Fritsch & Kuchinke, 2013; Hofmann et al., 2010; Jaanus et al., 1990; Kuchinke et al., 2015; Keuper et al., 2014; Ortigue et al., 2004; Pülvermüller, 2012; Schacht et al., 2012; Silva et al., 2012).

For example, if you have been raised with dogs, your personal concept "dog" will not just include how they (can and tend to) look, sound, smell, and feel when touched, but inevitably also how you relate to them affectively, with good or bad experiences leading to traces of positive or negative emotion, respectively. Growing up in an environment where

euthanasia is considered pure evil will inevitably add traces of negative affect to that concept. And if you have been raised in a family culture that placed a strict ban on the use of swear words (e.g., you would be forced to wash your mouth with soap whenever you used one), this is bound to add some traces of affect to your representation of the consequences of their use (see Jay, 2009). The same associative learning will inevitably shape the meaning of such things as emojis, intonation contours, or particular constructions (e.g., "*surely* you know that . . ."): to the extent that their usage reliably correlates with affective experiences, memory traces will simply be formed (see earlier discussion in this chapter; and see van Berkum, 2018, for a more detailed ALC analysis of word valence). Crucially, when the sign at hand is encountered again, these affective memory traces will be retrieved early in processing (see Citron, 2012, for neurolinguistics evidence).

Interpreting the Speaker's Communicative Move

The goal of language comprehension, however, is not to retrieve the stable meaning of words (and other signs) and combine those meanings into a "sentence meaning" in a way that respects the rules of grammar. The goal is to work out the contextualized "speaker meaning": What does X mean, *intend*, by presenting this composite sign to Y *here and now*? As indicated in Figure 29.1, these processes can take their cue from language, but also, and in principle no less powerfully, from other types of signs, such as a pointing gesture, a particular glance, or an emoji. And, as forcefully argued by pragmatics researchers (Clark, 1996; Levinson, 2006; Scott-Phillips, 2015; Sperber & Wilson, 1995; Tomasello, 2008), the processes involved do not just tie up a few loose ends after syntactic and semantic processes have done all of the serious work—they are a crucial part of why our species has such powers of communication. In the subsequent sections, (p. 751) I discuss the main types of inferential processes involved, primarily based on Tomasello's (2008) analysis.

Inferring the Speaker's Referential Intention.

One important ingredient of interpreting a communicative move is to *infer the speaker's referential intention*, i.e. to work out what concrete situation the speaker is talking about exactly, and to build a *situation model* that adequately reflects this (Johnson-Laird, 1983; Zwaan, 1999). With "Even *John* thinks euthanasia is acceptable in this case," for example, the addressee needs to work out who is referred to by "John," what is being asserted about this person, and, as part of that, what "this case" refers to. Because situation models are always complex multi-component structures, there may be multiple ECSs triggering an affective response. In the case at hand, for example, the entire situation described (i.e., the fact that even John thinks that such-and-such is OK) can be an ECS for the addressee, but the referent of "John" can also itself trigger emotions (e.g., when the addressee is not on good terms with this person), and the composite "euthanasia is acceptable" (a statement that might itself clash with moral values of the addressee) can do so, too. With "We've run out of dog food," the situation model computed by the addressee will depict, in some way, a situation in which the household at hand has no dog food in stock, and, based on plausible pragmatic inferences, in which the dog(s) living

there might thus get very hungry—owners who love their dogs will usually not be indifferent to that situation. Even the situation delineated by "The number 7 is *also* a prime number" can be exciting, or boring, depending on one's inclinations. The possibilities are infinite: whatever we can talk about, reality or fiction, verbally or nonverbally, might and *will* often be stuff we care about, too.

Inferring the Speaker's Stance.

A second ingredient of interpreting a communicative move is to *infer or detect the speaker's stance*, his or her orientation to a particular state of affairs or "stance object" under discussion (Du Bois, 2007; Kiesling, 2011; Kockelman, 2004). Stance has an epistemic and an affective side. Epistemic stance is about aspects of the speaker's knowledge state, such as when speaker X expresses, "The number 7 is *also* a prime number" in a way, signaled by tone of voice, facial expression, body posture, and so on, that conveys certainty and confidence, or uncertainty instead. Depending on circumstances, this can sometimes be a trigger for emotions. However, the speaker's *affective* or *evaluative* stance (Hunston & Thompson, 2000), his or her *emotional* orientation toward some stance object, will *as a rule* trigger emotion in the addressee. The reason is that we are simply immediately sensitive to such emotional displays of our conspecifics, via various evolutionarily sensible routes. These include several aspects involving empathy (Decety & Cowell, 2014)—simple emotional sharing ("resonance," "mirroring," "emotional contagion"), empathic concern ("caring for"), and affective perspective-taking (i.e., more deliberately imagining somebody else's feelings)—as well as various other rapid interpersonal interlockings of social emotions (Fischer & Manstead, 2016), such as when rage instills fear, admiration instills pride, and contempt instills shame, at least initially. Returning to our examples, if the math (p. 752) teacher utters, "The number 7 is *also* a prime number" with clear signs of annoyance and contempt, the addressee might feel ashamed, while signs of sympathy, patience, and encouragement will typically generate more positive emotions. The stance signals that might accompany "Even *John* thinks euthanasia is acceptable in this case"—signals that, for example, reveal deep sorrow, incredulous disbelief, rage, or contempt—will also easily trigger strong or weak emotion in the addressee. The same holds for stance signals accompanying "We've run out of dog food," such as those that betray unpleasant surprise, concern, or reproach.

While stance itself is usually detected relatively easily, what the stance is *about* often requires some additional computation. Speaker X's uncertainty or annoyance, for example, might be about what is being referred to, but also about addressee Y, about the communicative situation, or about the expected effect of the utterance. Also, the stance signals emitted by speaker X need not all have been communicated *deliberately*. Furthermore, in line with the fact that much of cognition and emotion is unconscious, addressee Y may be affected by these signals without being aware of it at all. Either way, the speaker's stance will have an impact on the addressee, via its contribution to the inferred social intention, but, unavoidably, also *by itself*.

In the example at hand, the *verbal* ingredients of the utterance single out a situation that X wishes to draw Y's attention to, and *nonverbal* ingredients mostly signal X's stance. But, as indicated by crossing arrows in the center of Figure 29.1, things can be otherwise. Referents can be signaled verbally but also entirely nonverbally, by such means as eye movements, manual pointing, or an iconic gesture (Tomasello, 2008). Also, epistemic or affective stance can be expressed through such nonverbal signs as tone of voice, but also by one's choice of words and constructions, in a wide range of subtle and less subtle ways (e.g., using "I guess that . . ." to express uncertainty, "just" to express non-commitment, or swear words to express strong negative stance). The division of labor between how verbal and nonverbal parts of the composite sign signal referents and stance can change with every utterance. In fact—and important to keep in mind—the comprehension process depicted in Figure 29.1 can also work without language (Levinson, 2006; Tomasello, 2008), as when we communicate something with a well-timed silence, a raised eyebrow, an emoji, or a sigh.

Inferring the Speaker's Social Intention.

Addressee Y's mental representations of speaker X's referential intention and (deliberately or accidentally conveyed) stance jointly provide the basis for the third ingredient of interpreting a communicative move, the *inferring of X's social intention*. What is it that speaker X presumably wants to achieve by making this specific move, here and now? The options are unlimited. However, according to Tomasello (2008), speakers have three major types of social motivations for communicating, often mixed in the same move, but conceptually distinct: (1) *requesting (or manipulating)*: I want you to do or know or feel something that will help *me*; (2) *informing*: I want you to know something because I think it will help or interest *you*; and (3) *sharing*: I want you to feel something so that we can share feelings together. Obvious verbal examples are "Please close the door"; "Hey, you dropped your wallet"; (p. 753) and "Isn't that a great view!" In the right context, similar intentions can be expressed by pointing to a specific open door, wallet, or view in a certain manner. Whatever the case might be, addressee Y needs to figure out what speaker X wants him or her to do, know, or feel.

The representations that we construct for an interlocutor's social intention on the basis of his or her referential intention and stance, as well as our own expectations, are usually emotionally competent, and sometimes very strongly so—after all, it is at *this* level that we deal with each other. In the prime number example, addressee Y might infer that X just wants to help, wants to make the addressee feel small, or wants to share amazement with him or her about this mathematical fact. In the dog food example, Y might infer that X wants him or her to go to the store and wishes to phrase this as a polite request, and/or that X wants him or her to feel remorse for not having done so before. And with "Even *John* thinks euthanasia is acceptable in this case," the social intention might be to persuade the addressee to agree to euthanasia, to mock the addressee for an obviously backward opinion, or to simply share amazement over the ease with which people apparently consider euthanasia. Note that the same utterance can realize very different social intentions, and that addressees can (and, unfortunately, fairly often do) infer

different intentions from the one the speaker had in mind. In any case, many of the strong or subtle emotions elicited by language use will arise at this level of interpersonal interaction, the level where we manipulate, help, or share feelings with each other.

Communication always involves an additional "special" social project: not only has the speaker decided to use language and/or nonverbal signs to realize his or her primary social intention(s), but he or she must somehow get the other person to (implicitly or explicitly) agree to and *collaborate on the joint communicative project* for a certain amount of time. The implication is that whenever speaker X is drawing Y's attention to his or her wish to communicate (e.g., by presenting words and other obviously communicative signs, possibly accompanied by special *for-you* signals such as eye gaze), addressee Y already knows at least *one* social intention, namely that speaker X is trying to realize whatever other social intention he or she might have via a communicative project. Importantly, the addressee may feel good about this, or not. If you are engaged in mental arithmetic and afraid to lose track, you may not want to be disturbed by communicated math trivia right now. If you are busy pondering your own view on euthanasia, you may not want somebody to tell you about other people's opinions. And if you are fed up with working on an exam or a paper, *any* remark from anybody might be a welcome distraction, even if it is about household supplies being low.

Inferring Bonus Meaning.

Working out speaker X's referential intention, stance, and social intention (and recognizing his or her communicative intention as a special case of the latter) completes the process of inferring or understanding *speaker meaning*, that which the speaker aims to convey or bring about. Some would argue that language processing stops there (e.g., Clark, 1996). But regardless of such discipline-based demarcation lines, *processing* doesn't of course stop there—addressee Y will consciously or (p. 754) unconsciously always infer (via associative memory retrieval or more sophisticated computation) at least some additional "bonus" meaning, things that X did not mean to convey at all, about speaker X (e.g., "X is a really kind teacher"; "X is getting rather forgetful"; "X is always bringing John up"), the relationship between X and Y (e.g., "X really thinks I can do better"; "X is always nudging me"; "X never listens to me") and the rest of life (e.g., "I may really have a talent for math"; "Dogs are a lot of work"; "How can people be so insensitive?"). Although not part of speaker meaning proper, such bonus meaning will usually strongly contribute to whatever Y will think, feel, do, or say next.

The Addressee's Current Emotional State Can Affect Processing

Finally, the addressee's current emotional state can also affect processing, in part fully independently from the speaker's communicative move and the active representations that reflect its analysis. First, a preceding event may have led to a strong emotion with attentional and other cognitive effects that impact further processing; such short-lived emotional state changes occur rapidly enough such that the beginning of an utterance can affect the processing of its continuation. Second, mood can impact cognitive processing in ways that are independent of whatever information happens to flow

through the processing system. This also holds for *language* processing, where mood has been shown to affect, among other things, syntactic parsing (e.g., Vissers, Virgillito, Fitzgerald, Speckens, Tendolkar, Van Oostrom, & Chwilla, 2010), referential anticipation (e.g., van Berkum et al., 2013) and the response to unexpected concepts in discourse (e.g., Federmeier, Kirson, Moreno, & Kutas, 2001). Furthermore, the current emotional state can interact with the valence of information flowing through the system (cf. mood incongruency effects; e.g., Egidi & Caramazza, 2014; Pratt & Kelly, 2008). The ALC model allows one to think about the impact of mood and shorter-lived emotional states in a more precise way, by localizing that impact in one or several specific component processes.

Additional Complexity

The structured nature of representations generated by linguistic communication allows for more complexity than discussed so far. First, because active representations of a given type can be nested in representations of the same type, ECSs can also be embedded in other ECSs. Such embedding was already exemplified at the situation model level ("Even *John* thinks euthanasia is acceptable in this case"), but interesting variants also occur at the level of social intentions. Consider "You are really ugly!" spoken by a friend in a benign teasing way. The social intention ultimately construed by the addressee should be one of playful teasing. However, the teasing part is achieved via a *pretended* insult (i.e., another social move). This embedding reveals the recursive creativity of human interaction: just like in art, people can always take an established communicative pattern and start "playing" with it. However, this also opens up the possibility that although the "outermost" social move is a positive ECS, the embedded social move can still serve as a negative ECS.

A second level of complexity arises in narrative, the stories people tell each other, such as when they gossip, write a novel, or report on events in the news. Such stories are (p. 755) usually about other people, *characters*, engaging with each other in a series of more or less fortunate events. Not only are these characters themselves affective creatures, caring about those events in ways that make sense from their own value systems, but we as readers or listeners affectively orient ourselves toward all that as well—this is precisely the fun of reading a novel, or gossiping about others. From a modeling perspective, things get very complex here. To the degree that we get transported into the story world (e.g., Slater, Johnson, Cohen, Comello, & Ewoldsen, 2014) and identify with particular characters, for example, we may momentarily take on somebody else's value system (i.e., not just see the world through their eyes, but *feel it through their emotions*). The result of this may well be something akin to bi-stable perception, with stimuli that can be, say, a positive ECS for the character you momentarily identify with in the story world, but a negative ECS for you in the real world (see also the following section). Furthermore, in narrative, the really exciting events are often *communicative* moves, requiring you to unpack the referential intention, stance, and social intention of the communicating character, just as you would with a real interlocutor. And then on top of all that, somebody—an author, a narrator—is *telling* you this story, with an affective stance of his or her own.

This is not the place to unpack this additional complexity, nor to suggest that with the current ALC model in hand, things will always remain tractable. At the same time, it should be obvious that with a less articulate model—one that does not at least separate signs from the speaker's referential intentions, stance, and social intentions plus some bonus, or one that merely characterizes the comprehender as a TCP/IP-decoding computer—we do not stand a chance at all.

Using the ALC Model to Interpret Neurolinguistics Research Findings

By combining established ideas from the psycholinguistics of word and sentence processing, the pragmatics of interpretation, and the nature of emotion, the ALC model makes explicit that emotion can in principle pervade *every* step of the language-comprehension process, and that mood and other aspects of one's affective state can in principle impact on *all* components of the comprehension process. Of course, this does not mean that every potential interface between emotion and language is always highly relevant to every bit of actual language use. What the model is supposed to do is list the options, and help researchers think about what the operative interfaces might be in the situations they wish to study, or have already studied. To illustrate this, I will briefly examine the results of a few neurolinguistics studies that I was involved in.

EEG Research on the Processing of Insults with Swear Words

In a recent EEG study, Struiksma, De Mulder, and Van Berkum (2018) examined the short-term impact of verbal insults. Participants read verbal insults that contained (p. 756) relatively coarse swear words (e.g., "<X> is a bitch"), insults without such swear words (e.g., "<X> is a liar"), and compliments (e.g., "<X> is a darling"), where <X> would be replaced by the participant's own name or that of somebody else. To examine the robustness of any differential insult effects, insults were repeated in homogeneous blocks (e.g., 30 insults targeting you) that occurred three times over the course of the experiment. Relative to compliments, insults with coarse swear words elicited an early P2 effect at 150–250 ms after presentation of the critical word, regardless of who was targeted by the insult. On the assumption that being referred to in a strongly negative way is more evocative for the person him- or herself than for somebody else, the insensitivity of this effect to who was being insulted suggests that the ECS at the root of the P2 effect is *not* the specific situation referred to, nor the (imaginary) speaker's social intention. What is more likely is that the swear word elicits this response at the level of the atomic sign (see van Berkum, 2018, for a swear-word-oriented ALC analysis of word valence), and/or at the level of the inferred stance of the speaker. The early timing of the ERP effect, and the fact that it does not diminish with rather massive repetition, speaks in favor of a sign-level ECS.

In the same study, insults with coarse swear words also elicited an LPP (late positive potential) effect around 350–500 ms, again regardless of who the target was. As with the P2 effect, such independence would not be expected if the ECS emerges at the level of the inferred referential or social intention. The ALC model suggests several other options.

One is that the LPP effect reflects some downstream consequence of the *same* sign-level swear-word-conditioned ECS that also elicited the P2 effect, such as, for example, increased conscious processing of salient signs. Another option is that the LPP effect is independently triggered by the inferred stance of the speaker, or by some bonus inference associated with that. The Struiksma et al. (2018) data do not allow us to decide the issue. What should be clear, though, is that the ALC model can help in delineating what the various sources of the response to verbal insults might be.

fMRI Research on the Processing of Face-Saving Indirect Replies

Bašnáková, Van Berkum, Weber, and Hagoort (2015) used fMRI to investigate the neural correlate of comprehending face-saving indirect replies. In a scripted job interview situation, participants queried several candidates over the intercom, and, at critical moments, received either a direct reply (e.g., “I am planning to take a language course this summer” to the question “What are your plans after graduation?”) or an indirect *face-saving* reply (e.g., “I am planning to take a language course this summer” to the question “Are you fluent in any foreign languages?”). In a different fMRI session, the same participants also overheard somebody else do the interview with the candidates. In both situations (i.e., as addressee or overhearer), the fMRI participants needed to fully process the answers to come to a candidate-selection decision.

Relative to direct replies, indirect face-saving replies engaged core nodes of the metalizing network (bilateral temporoparietal junction (TPJ), medial prefrontal cortex, and the precuneus), as well as structures associated with other non-emotional aspects of discourse complexity (bilateral BA45, BA47, anterior temporal lobe), and (p. 757) did so equally when fMRI participants were the addressees of these replies and when they were merely overhearers. This is compatible with the ALC model, in that cognitive perspective-taking, as well as other aspects of discourse-level comprehension, is a necessary part of inferring the speaker’s referential and social intention *regardless* of whether the listener is being addressed or overhearing. However, whether participants were the addressees of the face-saving replies or merely overhearing them did matter to whether indirectness additionally engaged *emotion-related* areas: face-saving indirectness increased activation in the left and right insula and the ACC *only* when fMRI participants were addressed themselves, not when they overheard the replies being given to somebody else. Note that in this study, face-saving replies are such that they “cover up” potential shortcomings of the job candidate, and can thus be seen to mislead or otherwise “socially navigate” the addressee. This may well explain why those addressed are uniquely, and *affectively*, sensitive to such replies. The ALC model provides two clear options as to where the addressee-specific ECS(s) might be located. One is the inferred social intention, which might involve emotionally evocative things like “he’s deliberately avoiding a straight answer to cover up his shortcomings” or “he’s playing me,” and may as such elicit irritation or other relatively arousing emotions. The other plausible location for one or more ECSs is the associated bonus meaning (e.g., stereotypical ideas about the type of person who would do such a thing). As presented in Bašnáková et al. (2015) in detail, the ALC model allows us to systematically think about which cognitive processes are taxed

equally by indirectness, as well as which of the resulting representations might specifically be emotionally evocative for addressees.

Facial EMG Research on the Processing of Morally Loaded Stories

In two recent studies, ‘t Hart et al. (2018a, 2018b) explored the processing of utterances such as “Mark was furious when . . .” or “Mark was happy when . . . ,” embedded in a narrative fiction context where the protagonist had just exhibited morally sound or morally bad behavior. Electromyographic recordings of corrugator supercilli (“frowning muscle”) activity suggested that the emotional response of readers in these experiments involved a blend of two processes: *simulating* what was being asserted, and *evaluating* what was being asserted. Evidence for the latter came from the observation that while readers frowned more when reading “Mark was furious” as compared to “Mark was happy” if the protagonist at hand had just been portrayed as a morally good person, they frowned *equally* to “Mark was furious” and “Mark was happy” if the protagonist at hand had just been portrayed as a morally *bad* person. This suggests that, as might be expected (Greene, 2014), readers have different emotions about something bad happening to bad people (e.g., *Schadenfreude*) as compared to something bad happening to good people (e.g., compassion). However, reading about furious versus happy protagonists also made an independent *additional* contribution to the recorded degree of frowning, indicating that our readers also had emotions as part of embodied language processing, in line with earlier work on this topic (e.g., Foroni & Semin, 2009; Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010).

(p. 758) The ALC model allows us to more precisely delineate these various sources of reader emotion. As for simulation, the increased frowning recorded when people read sentences such as “Mark is furious” can reflect the retrieval of the meaning of the lexical signs (in this case, of “furious”), and/or the construction of a situation model (i.e., imagining a furious specific protagonist). As for evaluation, the most likely source of emotion here is how the entire situation referred to relates to the reader’s own norms and values. In the fictional narratives at hand, the author’s stance or social intention is not very likely to be an ECS. However, it is easy to imagine narratives where the author’s or speaker’s stance and social intention do matter (e.g., blogs, gossip) and will thus have the potential to trigger additional emotion. In all, the ALC model helps in making explicit where the various weak and strong emotions that we have when we are reading or listening to stories may actually come from: all the usual options discussed earlier, *plus* the embodied situation-model simulation of *somebody else’s* real or fictional emotions.

EEG Research on How Mood Affects Language Processing

Language processing research with so-called implicit causality verbs has shown that when people read “David praised Linda because . . . ,” the verb and the surrounding construction lead them to anticipate more information about Linda, not David; if a subsequent pronoun is inconsistent with that expectation, as in “David praised Linda because he . . . ,” readers slow down and also display immediate processing costs that show up in the EEG, right at the critical pronoun (see van Berkum, Koornneef, Otten, &

Nieuwland, 2007, for data and review). Of relevance here, a follow-up EEG study (van Berkum et al., 2013) indicated that the anticipatory bias varies with the participant's current mood: while readers in a good mood do show EEG traces of verb-based anticipation at an expectation-disconfirming subsequent pronoun, readers in a bad mood no longer seem to anticipate who's going to be talked about next. In terms of the ALC model, at "David praised Linda because . . . ," a bad mood seems to down-regulate the rapid, real-time anticipation of the author's referential intention, plus possibly of the plausible signs associated with that anticipated referential intention (in this case, the word "she"). More generally, Figure 29.1 can be said to make the hypothesis space for mood effects on language processing explicit, with mood potentially affecting all processes depicted on the left, and potentially biasing processing toward particular representations on the right. In the experiment at hand, mood had an impact on the degree to which readers anticipated aspects of the referential intention. At the same time, the absence of a mood-modulated ERP effect to syntactic number agreement violations (van Berkum et al., 2013) indicated that, in this study, the comprehender's affective state did not affect aspects of syntactic processing.

Implications

So, is human emotion just a topic, a cause, or a consequent of particular instances of language use, cleanly separated from the machinery that does the language processing, and (p. 759) thus of little relevance to psycholinguistics? The central claim of the ALC model is: usually not. *Every* representation retrieved or computed as part of language comprehension can in principle be an emotionally competent stimulus, with access to the brain's affective systems via fresh appraisal or associative memory traces of past appraisal and emotion; that is, *for every communicative move*, the individual signs used by the speaker can be ECSs, the situation the speaker is believed to refer to may contain one or more ECSs, the speaker's stance is usually an ECS, the inferred speaker's social intention is usually an ECS (and there may be several such intentions packed in the same move), the communicative project may itself also be an ECS, and some part of the bonus meaning will often contain one or several ECSs. In addition, the resulting or prior background emotional state can tune and bias elements of subsequent language processing, in ways that reflect how mood, emotions, and evaluations tune other forms of cognition and action. In all, emotion does not just come into play after some "thermo-insulated" cold comprehension module has done its thing. The process of language comprehension is infused with emotion right from the start, and all the way through.

Although the examples discussed have often foregrounded spoken conversation, the ALC model is also about *written* language comprehension, such as when reading a text message on your phone, a blog on the web, a textbook in class, a tax letter on your doorstep, or a novel in bed. Also, with its equal foregrounding of verbal and nonverbal signs, the ALC model can easily be applied to multi-modal instances of communication, such as when words and emojis are mixed together during texting. In fact, we can take *all* of language out and use the ALC model to analyze the impact of completely nonverbal

communicative moves, such as an isolated emoji in WhatsApp, a raised eyebrow in face-to-face conversation, or a communicatively intended touch. The ALC model is really about the processing of communicative moves, whatever their form.

Who Is the Model for?

Apart from helping to make sense of past neurolinguistics research, the ALC model makes several interesting predictions that can be tested with neurolinguistics methods. First, signs that have been reliably coupled with particular affectively loaded representations (e.g., of the speaker's stance or intentions, or of the typical perlocutionary effects the sign has on others) should inject their affective payload extremely rapidly in the processing stream, a prediction that can be tested with EEG and/or MEG (for relevant evidence, see, e.g., Citron, 2012; Schacht et al., 2012; Struiksma et al., 2018; see also, in this volume, Leckey & Federmeier, Chapter 3, and Salmelin, Kujala, & Liljeström, Chapter 6). Furthermore, the ALC model predicts that at least five different levels of representation computed as part of language comprehension—signs, referential intention, stance, social intention, and bonus meaning—should each have some way of access to these emotion-relevant neural structures, a prediction that can be tested with functional and structural connectivity analysis. And peripheral measures such as skin conductance and facial electromyography (EMG) can help test the model's prediction (p. 760) that the different levels of representation disentangled by the model can all contribute to a reader's or listener's affective response, and that the acquired affective meaning of a linguistic sign can be related to each of the various potential sources of affect higher up in the model, as language is being used in particular contexts again and again.

Several other research communities might also profit from the ALC model. For linguists, psycholinguists, and communication researchers who are asking questions about language and emotion, the model can serve as a tool for thinking about existing findings and new research, and, inevitably, as a stepping stone toward a more adequate model. Furthermore, for those in different fields that use linguistic materials ("vignettes"), the ALC model can serve as a reminder of the complexity and multileveled nature of the stimulus comprehension processes involved. The idea that words can affect people in several ways that go beyond the obvious (what they refer to) is relevant not only to researchers in basic psychological and cognitive neuroscience research on emotion, morality, and social interaction, but also to researchers who explore institutional and interactional processes in the political, judicial, educational, medical, financial, or business domains.

Finally, as an explicit model of language processing that also minds emotion, the ALC model can perhaps do other work as well. The biases discussed earlier in the chapter have led to an approach to language processing that has been fruitful: we now know a lot more than before about how the brain cracks the language code. At the same time, the biases have drawn attention away from what we *do* with language because we care about "stuff." I frequently come across professionals who have a general interest in language

because of the social, verbal nature of their profession (e.g., coaching, teaching, advertisement, politics), but who feel that the language sciences currently have little to offer. Models like the once proposed here can perhaps help bridge the gap.

What if I Just Do Not Care?

What about the many researchers in language and communication who are not interested in emotion in their work? Can they just ignore the current analysis, or similar cases made by others (e.g., Besnier, 1990; Foolen, 2012; Jensen, 2014; Majid, 2012)? I would argue that even language scientists whose work is well removed from the interfaces with emotion should have some basic knowledge of what and where those interfaces are. One reason is that emotion is a powerful source of variance in language processing—a source one should be aware of and if possible control for, much like experimentalists routinely control for word frequency. More fundamentally, every language and communication researcher should know about the interfaces with emotion for the same reason for which those who work on, say, syntactic parsing should know a bit about phonology, semantics, and pragmatics, and why those working on text comprehension should know a bit about word recognition. We are looking at a structured yet integrated system, a bit of nature that, although it has joints to carve it at, and subcomponents to focus on, is not a collection of disconnected bits that can all be studied in isolation. If anywhere, that case can be made quite easily for emotion. People use language to refer to things they care (p. 761) about, and they use it to relate to each other, in ways that are almost never neutral. In the words of Nico Besnier (1990, p. 433):

> Affect permeates all utterances across all contexts because the voices of social beings, and hence their affect, can never be extinguished from the discourse.

If you combine Besnier’s fundamental observation with basic cognitive neuroscience knowledge about the role of emotion in cognition and action, and about emotional learning in the brain, it is actually quite difficult to see how the study of language *processing* can be complete if emotion is not included in the picture as well.

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Notes:

([1]) This chapter has overlap with Van Berkum (2018), particularly in the second and third sections. However, while in the latter paper, I explore the interfaces between language and emotion with swear words and present a model-driven discussion of the multifaceted nature of word valence, the current chapter has a somewhat stronger cognitive neuroscience orientation, discusses a wider range of examples, and applies the proposed model to specific neurolinguistics studies.

([2]) TCP/IP is a communication protocol that regulates information exchange between computers

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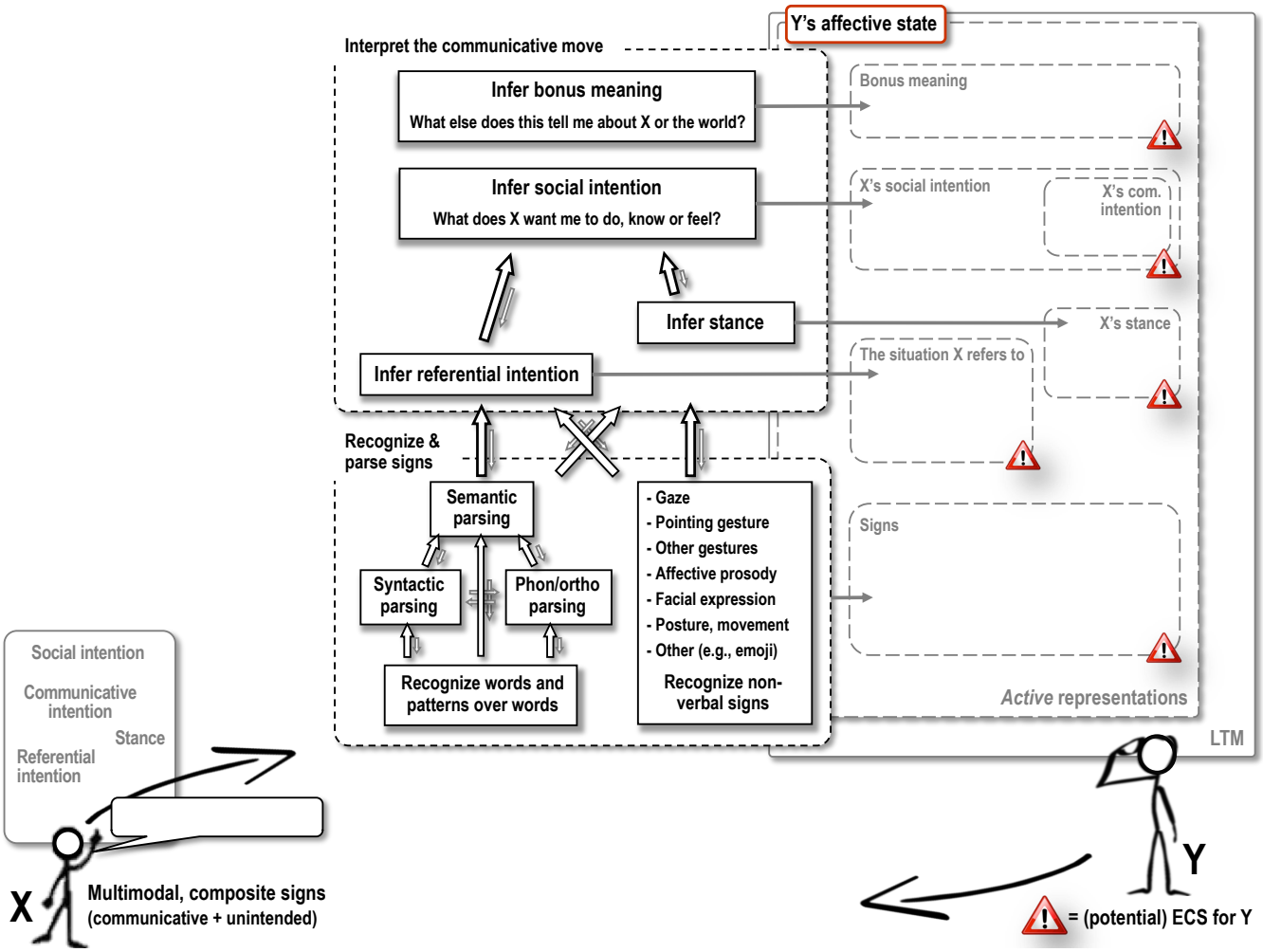

Van Berkum, 2019 Figure 29.1