Chapter 5
Sequence Package Analysis: A New Natural Language Method for Mining User-Generated Content for Mobile Uses

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Abstract Paradoxically, in an era when cyber-postings proliferate on the Web, much of the valuable information that can be mined from user-generated content (UGC) still eludes most mining programs. One reason this massive amount of UGC is, for all practical purposes, "lost" in cyberspace has to do with the limitations inherent in existing approaches to natural language understanding. In this chapter, I will explore how Sequence Package Analysis (SPA), a new natural-language data-mining method for text-based and spoken natural-language input, locates and extracts valuable opinion-related data buried in online postings—and makes such data available to mobile users. The SPA mining method can be used with existing SLM systems to assist in both *supervised* and *unsupervised* training. This chapter demonstrates that the advantage of SPA in such contexts is twofold: First, by breaking down unconstrained, open-ended natural-language input into relevant sequence packages, SPA can streamline the process of classifying a vast number of sentences (or spoken utterances); second, as the SPA algorithms become more robust, the process of collecting and classifying natural-language input can be automated entirely, thereby replacing human annotators with SPA-designed machine-learning. Using several examples, randomly selected from the TripAdvisor website, I illustrate how SPA can render the hidden attributes of online reviews (both positive and negative) more visible to the mobile user.

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Introduction

Paradoxically, in an era when cyber-postings proliferate on the Web, much of the valuable information that can be mined from user-generated content (UGC) still eludes most mining programs. In the mobile setting in particular, access to UGC may be even more critical. In Di Fabbrizio et al. (2013) the authors point out that "[c]onsumers on-the-go increasingly rely on internet search to find services and products, and on online reviews to select from among them" (p. 290).

One reason this massive amount of UGC is, for all practical purposes, "lost" in cyberspace has to do with the limitations inherent in existing approaches to natural language understanding. To wit, a semantic grammar-based system that looks to extract relevant sentences from online opinion reviews will skip over data where there is no exact match between the user's own description of a consumer product/service and the key phrases that are coded into the semantic grammar-based system. The same data may also be lost on a statistical language modeling (SLM) system, which may yield a confidence score that is too low for finding an acceptable probabilistic match between the user's description of a product/service and the corpus of annotated-training data contained in the statistical-language modeling system.

Consider just one category of UGC, for example: the ever-expanding repository of online consumer product and service reviews. This category covers a wide range of review subjects: restaurants and hotels; movies, concerts and tourist attractions; fitness spas and yoga classes; pharmaceutical products and medical devices. Proper analysis requires better natural-language methods, broad enough to recognize the diversity of expression contained in the text of such reviews. In addition, given the vicissitudes of market conditions and seasonal trends, new products and services are constantly being introduced to the marketplace, requiring the recognizer to process the new words and phrases contained in consumer reviews. In short, for a natural-language understanding program to be effective it must able to keep pace with the flexible vocabulary of user-generated content present on the web.

Dahl (2013) closely examines the various approaches to natural language understanding. She points out that speech recognizers that utilize a statistically-based approach to interpret the meaning of unconstrained natural-language input based on "the expected possibilities of words in a user's utterance, rather than grammars," are "more flexible than grammar-based recognizers for recognizing unexpected input." Nevertheless, Dahl cautions the reader about the evident challenges to building statistical systems:

> Because these are statistically-based systems, a drawback to SLM systems is that they require collection of significant numbers of the utterances that are used to train the system, up to tens of thousands in some cases. Moreover, not only must these training utterances be collected, but they must also be manually classified into their appropriate categories by human annotators. This is because the system develops the statistical preferences that it will use to categorize future utterances on the basis of human-annotated data. Training based on human annotation, or *supervised training*, is an expensive procedure. For this reason, training with little or no attention from human annotators, called *unsupervised training*, or *weakly supervised training*, is an important goal of work in this area, although the problem of effective unsupervised training is far from solved (p. 64).

In this chapter, I will explore how Sequence Package Analysis (SPA), a new natural-language data-mining method for text-based and spoken natural-language input, locates and extracts valuable opinion-related data buried in online postings—and makes such data available to mobile users. The SPA mining method can be used with existing SLM systems to assist in both *supervised* and *unsupervised* training. This chapter demonstrates that the advantage of SPA in such contexts is twofold: First, by breaking down unconstrained, open-ended natural-language input into relevant sequence packages, SPA can streamline the process of classifying a vast number of sentences (or spoken utterances); second, as the SPA algorithms become more robust, the process of collecting and classifying natural-language input can be automated entirely, thereby replacing human annotators with SPA-designed machine-learning. Using several examples, randomly selected from the TripAdvisor website, I illustrate how SPA can render the hidden attributes of online reviews (both positive and negative) more visible to the mobile user.

Background

For over a decade, my research on SPA has appeared in peer-reviewed journals and in refereed conference proceedings (Neustein 2001, 2004a, 2006a, b, 2007a, b, 2011, 2012). This work is cited by a number of AI-researchers. Those interested in data mining in call centers focus on SPA's potential to "caption the text"—that is, to find subtle features in call-center recordings such as "early warning signs of customer frustration" (Paprzycki et al. 2004). Others have noted the utility of SPA for applications other than call center operations. For example, SPA has been pointed to as possibly part of the broad spectra of "medical natural-language mining tools" that may assist in the successful classification of "affective" versus "informative" content found in health-related web postings (Denecke 2008). Finally, patent applicants have cited my publications on SPA to support their PTO (Patent and Trade Office) applications for data-mining technology (Gallino 2008; Blair and Keenan 2009).[1]

Adapting to Less-Than-Perfect Natural Speech

The basic premise of SPA is that natural language systems, instead of seeking to "train" humans to accommodate their speaking patterns to the speech interface, must be able to *adapt* to the less than perfect speech produced by humans. Speech in general is characterized by circumlocutions, ambiguities, ellipses and other vagaries that

[1] Though SPA has not yet been alpha/beta tested, that may change shortly given the emerging applications of this technology.

can render the search for keywords or key phrases by even the best robust-parsing methods now available to us an exercise in futility. SPA, however, works with the quirks and general imperfections of natural speech, unlike today's natural-language systems, which, when faced with convoluted speech, have learned the art of "sidestepping" such convolutions instead of trying to unravel their intricacies. This is not really surprising, given that natural language understanding does not mean computers truly "understand" natural-language input as humans do (Dahl 2013). That is, to make sense out of meandering, unconstrained, open-ended input, such systems normally fall back on the recognition of a key word or phrase, which can sometimes be guided by chance.[2] But what happens when a keyword or key phrase fails to show up in the convoluted speech input altogether? As one can see, such an approach to performing recognition on circuitous, winding speech input is not only far from foolproof but also fails to bring us closer to designing natural-language systems that can truly adapt to the way people speak in the real world.

SPA-Designed BNF (Backus-Naur Form) Table

In Neustein (2006b, 2007a, b, 2011) I've shown the way SPA adjusts to speech that is less than "perfect." The method is to offer a set of algorithms that can work with, rather than be hindered by, ambiguities, ellipses and other imperfections of natural language. By breaking down natural language into a series of related turns and parts of turns discretely packaged as a sequence of (conversational) interaction, I've designed a BNF (Backus-Naur Form) table consisting of 70 sequence packages. The parsing structures contained in each sequence package consist of a set of non-terminals—context-free grammatical units and their related prosodic features—for which there is a corresponding list of *interchangeable* terminals: words, phrases, or a whole utterance.

Like the BNF tables widely used to denote *syntactic* parts of natural language grammars, the SPA-designed BNF table that is used to identify conversational sequence patterns consists of parsing structures that provide for the incremental design of complex grammatical components from more elemental units. What distinguishes the SPA-designed BNF table from a conventional table, however, is that its parsing structures are not syntactic components, encompassing parts of speech and phrases, such as N, V, ADJ, NP, VP or ADJP. Instead, they are *sequentially-implicative* units, meaning that their formal grammatical representation is defined by sequence as opposed to syntax (Neustein 2001).

[2] Dahl (2013) provides an excellent example of how systems using "[t]ext classification, in combination with statistical speech recognition based on statistical language models (SLMs)," can accurately interpret what a caller is saying "even on very indirect requests":

User: "I've been on in and out of the hospital and I know I'm late on it and I'm… I'm… I'm wondering, I'm out of the hospital now and they finally took my cast off, but I still can't work and I can't walk and I'm wondering…."

Classified as "Caller would like to get an extension on paying his utility bill" (pp. 63–64).

By relying on the sequence package in its entirety as the *primary* unit of analysis, rather than on isolated syntactic parts (such as N, V, or NP), the SPA-designed BNF table is able to depict the conversational sequences actually found in natural language input. Using an SPA-designed BNF table of multi-tiered grammatical structures, many of the subtleties, convolutions and complexities of natural language can be more effectively represented. For example, a "very angry complaint" is represented on the BNF table as the normal accretion of more elemental parsing structures, such as assertions, exaggerations and declarations.

The utility of SPA is that in parsing dialog for its relevant sequence packages, the SPA-designed natural-language interface is able to extract important business-intelligence data, including some of the more subtly expressed emotional content. It can achieve this by looking at the placement, order, and arrangement of the *totality* of the context-free grammatical units and components that make up each sequence package. Furthermore, since natural speech consists more of a composite of sequences than a string of isolated keywords or phrases, it is clear that speech applications and text-analytic mining programs equipped with the kind of sequence structures illustrated in the table can better accommodate how people really talk.

SPA's Hybrid Approach to Natural Language Understanding

To identify sequence packages, SPA uses a hybrid approach. In part, SPA's method is semantic grammar-based, for those clearly defined sequence packages that contain specifically marked boundaries and specifying package properties; in part, SPA's method is statistical, using *N-grams* to depict the probabilistic occurrence of a sequence package structure when one is not so clearly defined. However, since sequence packages are both domain-independent (Neustein 2011)[3] and language-independent (Neustein 2004b),[4] the costs of using a statistical approach are not prohibitive as they are for those applications where "data changes dynamically," requiring an expanding vocabulary to accommodate the new words for each new product, as "is the case for seasonal applications" (Dahl 2013) (p. 65).

[3] Neustein (2011) states, "Sequence packages are frequently transferable from one contextual domain to another. What this means is that many of the same sequence package parsing structures (whether they are single or multi-tiered) found in call center dialog may be found, for example, in conversations between terror suspects, doctors and patients, or teachers and students" (p. 5). Similarly, many of the same sequence package parsing structures found in text-based (as opposed to spoken) natural-language input are transferable from one domain to another. Regardless of the genre of user-generated content, the same sequence package parsing structures can be found across the wide range of topics discussed in online communications, from restaurant reviews to heated political discussions.

[4] Neustein (2004b) showed that by focusing on the social organization of talk, rather than on a sentence or an isolated syntactic part, SPA may be applied to a wide range of other languages because "*all* forms of interactive dialog, regardless of their underlying grammatical discourse structures are ultimately defined by their *social* architecture" (p. 2) (emphasis in the original).

Whether a rules-based or statistical language modeling approach is used, the main focus of SPA is to accommodate to locally (contextually) produced natural-language data by mapping out the orderly sequence packages that emerge as *indigenous* to natural language (Neustein 2001), both as speech and as text . For this reason, the BNF table described above is specifically designed to capture the spoken and text-based sequence patterns which are constituted in situ; that is, within the local, situated context of the unfolding dialog or online-posting.

Methodological Origins

In constructing algorithms that portray conversational sequence patterns, SPA draws from the field of conversation analysis, a rigorous, empirically-based method of recording and transcribing verbal interaction (using highly refined transcription symbols to identify linguistic and paralinguistic features (Atkinson and Heritage 1984)) to study how speakers demonstrate, through the local design of their speaking turn, their understanding and interpretation of each other's social actions. While conversation analysis is principally directed at the study of human-human interactive dialog in both formal settings—such as courtrooms, classrooms and hospitals—and informal everyday conversations, more recently some conversation analysts have applied particular aspects of this important body of research to the study of human-computer interaction.

For example, in Moore et al. (2011) and Moore (2013) Moore and his colleagues have examined online query searches by relating some of the basic principles of ethnomethodology and conversation analysis to this area of study. Moore (2013), in studying how referential practice is organized in the context of search-engine interactions, showed how certain interactions with a GUI uncannily resemble human-to-human conversation. Pointing to the conversation analytic finding of Sacks and Schegloff (1979) that speakers display two structural preferences when making reference to persons in telephone calls, one for "minimization" (the use of a *single* term, such as a first name) and the other for "recipient design" (that the term is recognized by the other speaker), Moore showed that web searchers, likewise, show a preference for formulating their queries by using short, simple terms (such as names) for the entity that constitutes their online search.

Building on this argument, Moore revealed how even the nature of the repair work that occurs in conversations when reference terms are not recognized by the other speaker (such as the name of the third person mentioned in the conversation), closely resembles the repair work performed by web users when an online query search fails to bring up the desired information. In a conversation, as Moore points out, "sometimes the recipient cannot be expected to recognize the name of the third person (e.g., Daniel). In such cases, the preference for minimization is relaxed just enough to enable the recipient to achieve recognition through combined references forms or descriptions (e.g., Daniel, the guy who cuts my grass)" (p. 262).

However, as soon as recognition is achieved in conversation, those lengthier, more roundabout descriptions are immediately abandoned for the short, single reference

terms because "speakers seek mutual recognition with the fewest words or least amount of interactional work possible" (p. 262). Moore showed that the same holds true for search engine interactions. That is, after names fail to bring up the desired search results and users must, instead, resort to generic descriptions, users immediately abandon those lengthy generic descriptions, once the correct name for the search item is (apparently) learned, in favor of using the correct name in all of their subsequent online searches.

In fact, since conversation analysis is informed by ethnomethodology—the study of how social interactants accomplish the situated production of social order in their day-to-day activities—I suspect that we will eventually realize that many of the research findings of conversation analysts detailing "how speakers locally organize *talk-in-interaction* through generic, but situated sequential practices" may be applied to the study of some of the nonverbal ways that social interactants "locally achieve order in concrete social settings" (Moore 2013) (p. 263). Users' in situ interactions with search engines, as discussed above, serve as a good example of the application of conversation analysis to text-based interactions.

Certainly, the application of ethnomethodology to better understand, in more general terms, human interactions with GUIs does not present a novel concept. Lucy Suchman (1987) argued nearly three decades ago in *Plans and Situated Order* that system designers must be cognizant of the fact that user interaction with machines, as with humans, is a characteristically ad hoc, situated achievement that does not lend itself to an a priori designation of plans and goals. Hutchby and Wooffitt (1998) point out that "Suchman's work has had an important impact on the field of system design. Not only did it propose a strong critique of the user as plan-following and goal-seeking, but it introduced the significance of *conversation analysis* … to a community of system developers" (p. 243) (emphasis supplied).

As we have seen, the methodological groundings of SPA provide a rich, substantive basis for formulating a new natural language method that is in synchrony with the conversational sequence patterns of both spoken and text-based natural language input. By studying natural language input as it is produced in situ by tweeters, bloggers, and social networkers (and anyone else who fits into the more general category of online reviewers or posters), SPA equips natural speech systems with a keener understanding of the messages conveyed in user-generated content posted on the Web. In practical terms, what this means is that an SPA-driven natural-language system could mine the web for valuable feedback on consumer products and services that would have otherwise remained hidden, as well as provide critical systems with homeland-security intelligence data that could have all too easily been overlooked by conventional mining programs (Neustein 2006b).

Methodological Caveats

As we have seen in the prior section, there are benefits to drawing from the conversation analytic literature for the design of natural-language systems that can accurately represent the dynamic, in situ organization of human communication, whether it takes the form of spoken language input or online-community postings. Nonetheless,

in the interest of fairness, I will take a moment here to present the views of those within the conversation analytic field who have objected to the derivation of programming rules from what has been learned about the systematic and orderly features of human communication. After all, the caveats they pose can only serve as helpful reminders of the obstacles that must be rigorously overcome:

1. In Button et al. (1995) the authors assert that "inferential possibilities of a sentence" are refractory to programming rules (p. 176). They use this argument to support their objection to the use of conversation analysis as the source of programming rules.
2. In Button (1990) the author asserts that the rules operating in conversation are not "codifiable" or "reducible to an algorithm" (p. 84).
3. In Schegloff (1992) the author points out that "possible [turn] completion is something projected continuously (and potentially shifting) by the developing course and structure of the talk," (p. 118) rendering human dialog too unpredictable and changeable, moment to moment, to be reduced to a set of programming rules (Button and Sharrock 1995).

Here are the principal counter-arguments posed to such caveats:

1. Gilbert et al. (1990) contradict those who assert that human dialog is resistant to programming rules simply because the meaning of utterances present limitless possibilities for interpretation depending on context. They start by pointing out that speakers, in their day-to-day interactions with other speakers, routinely work in situ to achieve order by redressing the contextually-dependent indigenous meaning of utterances so that meaning is not left entirely open-ended and subject to manifold interpretations: "… [because] the meaning of specific terms or expressions is not fixed, as in a dictionary definition, nor computable using simple rules of deduction, but dependent on the context in which the item is embedded [t]he hearer has to *work actively to find a meaning for the term which makes sense within that context*" (p. 254) (emphasis supplied).
2. In Gilbert et al. (1990) the same authors, describing this orderly way in which interlocutors redress the open-ended possibilities for interpretation caused by contextually-dependent meaning, draw an analogy to computing. They show that just as in human-to-human interactions, speakers overcome the problem of context-dependent meanings by treating new material as an instance of a presupposed underlying pattern against which new material can be interpreted, in computational modeling "the grammar a chart parser operates on will have alternative 'patterns' against which the input can be matched" (pp.255–256).
3. Hirst (1991) who, more than two decades ago, espoused the use of conversation analysis in natural speech systems, has stated: "it is clear conversation analysis must have a role in Natural Language Understanding because there is a sense in which [conversation analysis] is just a small sub field of artificial intelligence" (p. 225).
4. Hutchby and Wooffitt (1998) point to the impoverished methods of those who design interactive systems without a full appreciation of conversational analytic findings: "there has been an unfortunate tendency to discuss aspects of conversational organization … in the abstract, removed from empirical materials"

(pp. 244–245). It is further believed "that in order to design computer systems which either simulate, or more ambitiously reproduce the nature of human communication, it is necessary to know about the ways in which everyday (conversational) interaction is organized" (p. 241).

Yet so far, with all the pronouncements about the benefits of using conversation analysis for computer modeling of natural speech, no one has introduced a detailed approach that applies conversation analysts' empirical findings on the generic orderly sequences that emerge in situ in *talk-in-interaction* to successfully build simulacra for human dialog. This is where SPA finds its purpose: to provide an algorithmic framework, bridging the empirical research findings of conversation analysts with the design constraints of natural language modeling. The next section provides illustrations of how SPA extracts useful data often obscured in user-generated content.

Illustrations of Indigenous Sequence Packages

Finding the Hidden Negative Attributes in Online Consumer Reviews

In this section, I show how an SPA mining-program can be applied to consumer reviews of a fast-food restaurant, which may prove critical in a mobile setting given that users "on-the-go" may be more likely to stop at a fast-food place than to eat at a restaurant that would require a reservation. I randomly chose to examine two reviews posted in the past 4 months for the "Falafel Drive-In" in San Jose, California. These reviewers were found on TripAdvisor, a popular web site for consumer reviews of restaurant, hotel and travel services.

Example One

Below is the unedited text of a consumer review posted to TripAdivsor. The reviewer's punctuation, including use of n-dashes, is reproduced below just as it appears in the online posting.

TripAdvisor

"Falafel Drive-In" in San Jose

"Excellent Falafels and Shakes!"
Reviewed August 4, 2012 (5-star rating)
(Value, service, atmosphere and food: not separately rated)

I've been here 4–5 times at least and I never leave disappointed. Parking can be tough during the lunch crowd but it is totally worth it. There is typically a line—a good sign in my opinion! They have a small indoor seating area but tons of outdoor seating. The falafel is excellent. I always ask for a side of their hot sauce because it's

that good! The falafel combo deal is great because it is cheap and it comes with their fantastic banana shake! The banana shake is the best I've ever had! They do not accept credit cards, only debit and cash so come prepared. This place is a must if you leave [sic] in San Jose! Excellent, just excellent!

Sequence Package Parsing Structures
<Opening Endorsement> *"I've been here 4–5 times at least and I never leave disappointed"*
<Complaint/Disclaimer (Parking)> "Parking can be tough during the lunch crowd but it is totally worth it"
<Complaint/Disclaimer (Waiting)> "There is typically a line – a good sign in my opinion!
<Complaint/Disclaimer (Seating)> "They have small indoor seating but tons of outdoor seating"
<Opinion Review> *"The falafel is excellent. I always ask for a side of their hot sauce because it's that good! The falafel combo deal is great because it is cheap and it comes with their fantastic banana shake! The banana shake is the best I've ever had!"*
<Complaint/Disclaimer (Payment)> "They do not accept credit cards, only debit and cash so come prepared"
<Closing Endorsement> *"This place is a must if you leave* [sic] *in San Jose! Excellent, just excellent!"*

Analysis

In this restaurant review, cited above, though the consumer gave the restaurant a 5-star overall rating, she subtly pointed out a number of problems (difficulty parking, waiting in line, limited indoor seating and payment restrictions) which may be of importance to other consumers in deciding whether to patronize this drive-in eatery. Conventional mining program that extract relevant sentences and collocated words and phrases would not be readily able to detect opinion data when it is cloaked in this way. In contrast, as will be shown below, the sequence package structures contained in this online review are of such a generic kind that the opinion data, no matter how subtle or indirect, would not escape an SPA-designed mining program. For the purpose of this illustration, and the subsequent illustrations presented below, I will concentrate on SPA components, which are the larger parsing structures, rather than their smaller units. Since all components are derived from their smaller parts, an SPA mining program would naturally have both the smaller structures from which the larger ones are built.

What emerges indigenously in this online review is a sequence package known as a *contrastive pair* (Neustein 2001). The type of contrastive pair that is found here is the "complaint/disclaimer" pair. That is, each time a complaint is made it is immediately followed by some sort of a "disclaimer." The disclaimer may take the form of a justification, rationalization or solution. Whatever form it takes, its effect is the same, as it serves to "downgrade" or nullify the complaint.

Figure 5.1 below shows the series of four complaint/disclaimer contrastive pairs found in this online review. Three of these contrastive pairs are consecutive, sandwiched between the opening endorsement and the opinion review, while the fourth one appears immediately after the opinion review. The reason for the appearance of the last complaint/disclaimer pair after the opinion review and not before it (as was the case with the prior three complaint/disclaimer pairs) is mainly topical. That is, the last complaint/disclaimer pair refers to post-eating conditions in the restaurant (i.e., payment), whereas the first three pairs are relevant to conditions prior to eating (parking, waiting in line, and seating).

Figure 5.2 below shows the grammatical structure of the second part of the contrastive pair, which begins with a concessive connector ("but", "so," "n-dash"), otherwise referred to by conversation analysts as a "contrast marker," followed by an idiomatic expression or metaphor. (Here, idioms are defined rather broadly to include banalities, platitudes and clichés that serve as a "shorthand" way of getting the message across—in which their connotative meaning is not necessarily deducible from the individual words that make up the idiom.) Since conversation analytic studies have shown that idioms and metaphors serve special purposes, we can see from this posting that the online reviewer's use of these expressions has not occurred arbitrarily. Metaphors have been found to be helpful in achieving topic transition in conversation (Drew and Holt 1998). In this example, "tons of seating" is followed by a topic transition away from the series of complaints to the rendering of an opinion review of the drive-in ("The falafel is excellent …).

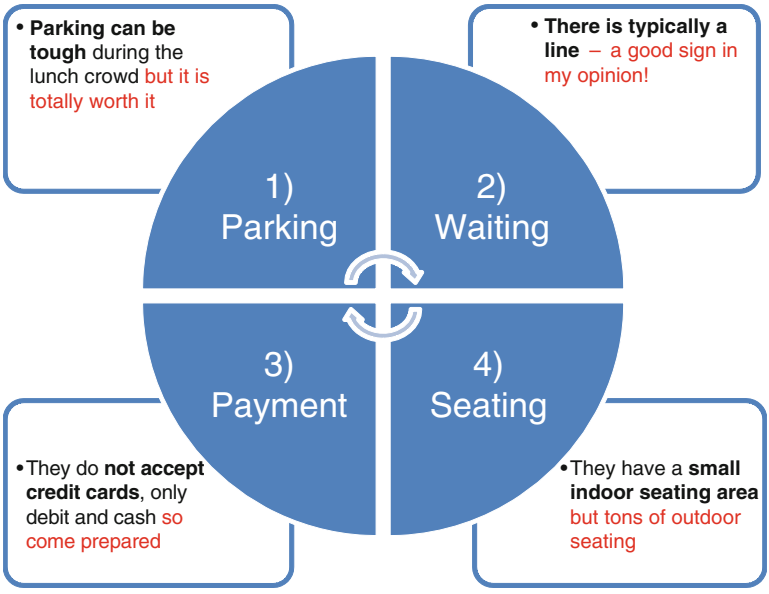

Fig. 5.1 *Complaint/Disclaimer Contrastive Pair* (each contrast utterance begins with a concessive connector, referred to here as contrast marker: "but," "so" or an "n-dash")

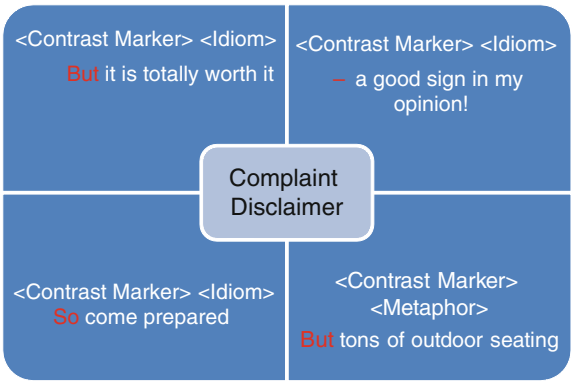

Fig. 5.2 Parsing structures of second pair part of complaint/disclaimer contrastive pair: contrast marker followed by idiom or metaphor

Idioms fulfill another function as well. They achieve indefeasible arguments because the idiom, itself a product of a culturally established "stable body of knowledge," is not subject to challenge (Drew and Holt 1988; Pomerantz 1986; Torode 1995). Consequently, when there is a dispute, idioms can be used rather skillfully to forge consensus. In Pomerantz (1984) the author examined dialog in which one of the speakers reverses her position on a sensitive matter by supporting "the newly affirmed position with … (an) aphorism" (p. 161). Similarly, in this TripAdvisor posting, the reviewer uses an idiomatic expression each time she seeks to nullify or disclaim her criticism of the falafel joint so as not to appear to be in a dispute over the services and conditions of this place.

N-grams for Sequence Packages

Contrastive pairs, such as a complaint/disclaimer, would be spotted by an SPA recognizer, using *N-grams* to spot the collocation of the first pair part vis-à-vis its attendant contrastive-pair second pair part in much the same way that statistical models have been trained to look for a contiguous sequence in the form of *bigrams*, *trigrams*, or *N-grams*, "techniques that automatically produce large numbers of collocations along with statistical figures intending to reflect their relevance" (Smadja 1991) (p. 279). Thus, following the approach of statistically-based language-modeling systems, SPA relies on *N-grams* to produce the statistical probability for the occurrence of collocated sequence package structures, such as complaints and their disclaimers, from which the system can then extract the more subtle aspects of consumer reviews that may be hidden from conventional recognizers.

In essence, SPA systems perform a type of "robust parsing," but rather than parse spontaneous speech for its "individual [semantic] segments that make sense within the defined task" (Pieraccini 2012) (p. 163), SPA parses the natural-language input for sequence package structures that are relevant to the defined task, such as the posting of online reviews of products and services. In such postings, it is fairly common to find sequence packages of complaint/disclaimer contrastive-pairs interspersed among the

Fig. 5.3 *Opinion sequences*

more rudimentary *opinion sequences*. In Fig. 5.3 above the three variants of opinion sequences: opening endorsement, opinion review and closing endorsement are shown.

Complaint Sequences Versus Opinion Sequences

It is easy to see why this series of complaint sequences is buried in this online posting. First of all, given the fact that many reviewers are reluctant to criticize a recognized establishment, negative feedback often takes the form of an indirect statement. Producing a disclaimer—joined to the complaint by a concessive connector or contrast marker—immediately after the complaint provides a diplomatic way to retreat or withdraw from one's position. Though a mining program can't read the reviewer's mind, her production of a series of complaints, each of which is disclaimed immediately afterwards, demonstrates the reviewer's predisposition to minimize anything problematic about the "Falafel Drive-In." If the reviewer retreats, then how can a mining program inform other consumers about the restaurant's downside? That is, when such complaints are routinely being minimized by online reviewers seeking to diminish the importance of their own uncomplimentary feedback, how can this information become available to other customers who may benefit from knowing ahead of time the drawbacks of the enterprise?

Though this presents something of a conundrum, an SPA-designed mining-program would try to solve the problem by first taking into consideration that opinion sequences (opening endorsement, opinion review and closing endorsement) are themselves indigenous features of the online posting. That is, the opinion sequences used to appraise this restaurant are produced in situ—so much so that the reviewer's consistent retreat

from each complaint she raised contributed to her 5-star overall rating for the eatery (though she failed to individually rate the four specific categories on *TripAdvisor*: service, food, value, atmosphere). Her rating was matched by her highly favorable review headline (appearing in TripAdvisor's "title of your review" box), which read "*Excellent Falafels and Shakes*!" A *cycle* matrix diagram has been used in Fig. 5.1 to demonstrate that each complaint/disclaimer contrastive pair is no more or less than part of a cycle that informs the overall restaurant rating as an in situ achievement.

Thus, by examining the indigenous arrangement of sequence packages in natural-language communications, the mining program would be able to detect how the *superlative* rating was arrived at in the first place. In this case, it was the result of the reviewer's disregard for the concerns that she herself raised about parking, seating capacity, waiting in line and restricted payment methods. True, one might alternatively argue that such concerns did not trouble this reviewer in the first place, especially given her 5-star rating followed by her superlative assessment. We may never know exactly what was in this reviewer's mind. But that is not to say that the issues she raised would not have been important to another consumer who may have shied away from a restaurant with parking problems, long lines, limited indoor seating and no credit card payments accepted.

All in all, the reviewer's backpedaling from her complaints and her resultant provision of an outstanding overall rating should not preclude the mining program's ability to extract what might be, to mobile users, invaluable information in their search for a fast-food restaurant to have a quick meal. At the very minimum, what this example shows is that if we unravel these indigenous sequence packages, the kernels of data that have become submerged in the convolutions of natural-language postings can be brought to the surface and made available to mobile users.

Example Two

Below is the unedited text of a consumer review posted to TripAdivsor. The reviewer's punctuation, including the use of elliptical dots, is represented below just as it appears in the online posting.

TripAdvisor

"Falafel Drive-In" in San Jose

"Great food!"
Reviewed April 22, 2012 (5-star rating)
Value, service, atmosphere, and food (5-star rating on all features, except atmosphere which was given four stars).

We read all the great reviews and decided to give it a try. We only had a short time for lunch and this was perfect. Both of us had the falafel sandwich; I had a banana shake, my husband a vanilla shake. Well, everything was great. The ingredients were fresh. The sauce was yummy. The sandwich fell apart after a while but we just continued eating it with a fork.... No problem. The service was very fast.
Great place. We recommend it!!

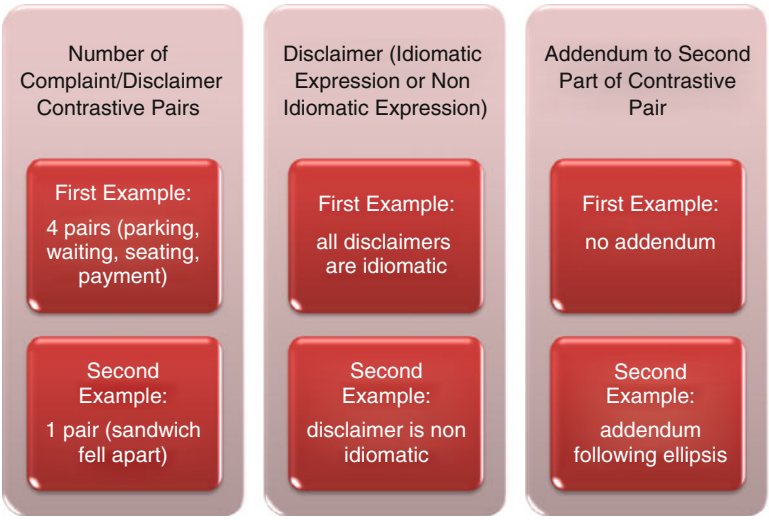

Fig. 5.4 Comparing the differences in sequence package structures between the first example and the second example

Sequence Package Parsing Structures
<Opening Third Party Assessment> <Personal Narrative> <Endorsement>
"We read all the great reviews and decided to give it a try. We only had a short time for lunch and this was perfect."
<Personal Narrative>
"Both of us had the falafel sandwich; I had a banana shake, my husband a vanilla shake."
<New Topic Interjection Marker> <Opinion Review>
"Well, everything was great. The ingredients were fresh. The sauce was yummy."
<Complaint/Disclaimer> <Ellipsis> <Formulation>

"The sandwich fell apart after a while but we just continued eating it with a fork.... No problem"
<Opinion Review>
"The service was very fast."
<Closing Endorsement>
"Great place. We recommend it!!"

Analysis

This online review, while providing a 5-star rating (just as in the first online review), nonetheless demonstrates a variation on the sequence package arrangement found in the prior example. Below are the differences, which have been outlined in Fig. 5.4.

1. There is only one complaint/disclaimer contrastive pair in the second example (*"The sandwich fell apart after a while but we just continued eating it with a fork.... No problem"*) as opposed to a series of four complaint/disclaimer pairs found in the first example;
2. The disclaimer in the second example, unlike in the prior review, does not take the form of an idiom or metaphor; instead, following the contrast marker, a straightforward complaint resolution statement is provided ("but we just continued eating it with a fork");
3. A special addendum to the complaint/disclaimer contrastive pair is found in the second example, but not in the first. The addendum consists of a "formulation"—a grammatical device, closely studied by conversation analysts, that allows a speaker (or an online reviewer in this instance) to use some part of the dialog (or posting) to "formulate" or "sum up" the activity he/she is presently engaged in (Heritage and Watson 1979). The formulation, which takes the form of an idiomatic expression ("No problem"), permits the reviewer to "sum up" her complaint as something that is *not* important in the least.

It is interesting to note that the reviewer placed an ellipsis, a series of three dots (…) right before she "summed up" her disclaimer with the use of an idiomatic expression: "but we just continued eating it with a fork.... No problem." In fact, given that in all natural-language communications order is achieved in situ, that is, in the local, concrete setting where the communication takes place, it was neither arbitrary nor accidental that a formulation was produced immediately following the ellipsis.

The warrant for this is as follows: because an ellipsis conveys an *unfinished thought*, one which allows readers to project their own thoughts into the omission represented by the ellipsis, it would have been risky to leave it to the reader to determine whether using a fork to eat a sandwich that has already disintegrated represents a viable solution to the problem of the sandwich having fallen apart. By employing the grammatical device of "formulation," and in particular an idiomatic expression which works to ensure agreement to something that may be open to dispute, the online reviewer was able to effectively seal up the open-endedness of her complaint-disclaimer ("but we just continued eating it with a fork … No problem").

There is yet another reason for the appearance of this particular sequence package design, consisting of a formulation appended to the disclaimer (creating a stronger and more definite retraction than disclaimers that are not followed by such formulations). The reviewer's use of this particular sequence-package design shows that she may be exercising caution when providing any sort of negative feedback about the eatery, most likely because from the very beginning this reviewer knew she was assessing a well-known San Jose restaurant that had already received so many laudatory reviews on TripAdvisor.

Unlike the prior reviewer, who announced that she had been to this restaurant a number of times before and was always pleased (*"I've been here 4–5 times at least and I never leave disappointed"*), the second reviewer acknowledged the stream of laudatory reviews and that her position was that of a novice: *"We read all the great reviews and decided to give it a try.*" By placing herself as a "newcomer" to this

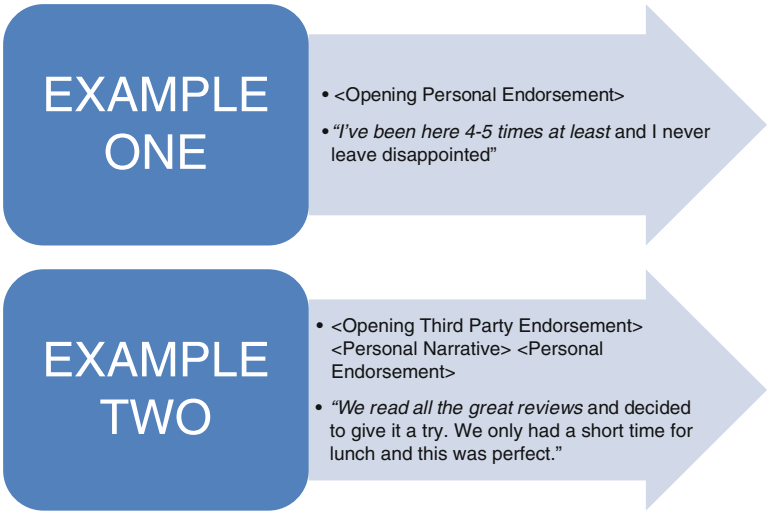

Fig. 5.5 Comparing the sequence package parsing structures used by the novice versus the seasoned visitor to this restaurant

well-known establishment—and readily acknowledging the praiseworthy reviews already posted by the other patrons—she implicitly set up her review to be measured or weighed against her (virtual) community of peers who had already supplied theirs. Figure 5.5 above shows the stark contrast between these two reviewers—one a novice, the other a regular—mapped out in the sequence package parsing structures that make up the opening statement of each review. To wit, the first example begins with a "personal endorsement" whereas the second begins with a "third party endorsement."

In actuality, even though online communities are virtual (and mostly anonymous: reviewers rarely use their real names, or if they do they do, usually their first names only), we cannot presume that the same sort of peer pressure found in real (non virtual) communities doesn't exist in virtual ones. In fact, many of the same social constraints found in real communities may be found in virtual ones as well. For example, sometimes peer pressure is not intended to forge consensus, expressed in the sharing of the opinions of others, but the exact opposite. We see this in those online postings from reviewers who, as *non locals*, seek to reinforce their position as "outside" the virtual community of local reviewers. In such cases, the leitmotif of their review postings can be that of noticeable "disagreement," as to opposed "consensus," with the prior online reviewers. Here is a brief example of such a review posting from a Houston couple of the San Jose-based Falafel Drive-In.

"I don't get it …"
Reviewed June 28, 2012

We drove directly here from the San Jose airport because of all the raving [sic] reviews. But to us it was just average, if this is the best falafels in town, then y'all

need to visit Houston, Texas. This food would not make the top. The falafels were burned on the outside and dry, and the banana shakes were small for the price. The food was just OK but really not worth raving about, for San Jose it is fantastic, for the rest of us … average.

The post of this Texas couple, unlike that of the San Jose local who displayed a preference for camaraderie with her local online community, the Houstonians have openly challenged the complimentary consumer reviews that had appeared on TripAdvisor: "We drove directly here from the San Jose airport because of all the raving [sic] reviews. But to us it was just average." Their opening statement about their discordant review is immediately followed by a litany of graphic complaints: "the falafels were burned on the outside and dry, and the banana shakes were small for the price." (Note that there are no complaint/disclaimer contrastive pairs here, which, as we've seen in the prior examples, serve to minimize or nullify the complaint.) The Houstonians conclude their review with a reconfirmation of their opinion of this eatery, one antithetical to the opinions held by the San Jose locals: "The food was just OK but really not worth raving about, for San Jose it is fantastic, for the rest of us … average."

Returning to the review of the San Jose couple discussed above, one can see that by virtue of their mention of the other "great reviews" of the Falafel Drive-In, the online reviewer immediately set herself up for a *test* as to whether she would be able to follow in the footsteps of her virtual community members, who had already supplied a number of online reviews praising this enterprise. For this reason, we are able to understand why it is that when she reported that her sandwich "fell apart"—a complaint that may be of particular interest to someone on-the-go who stops by a drive-in to grab a sandwich for eating either in the car or while hurriedly walking back to the office—she had to do serious repair work to back away from a complaint that would have put her at odds with the "great reviews" already posted by her virtual peers. The grammatical device of "formulation" produced as an addendum to the complaint/disclaimer contrastive-pair served as an effective way of backpedaling from her complaint.

In short, when comparing the reviews of the San Jose online reviewers—one a newcomer to the restaurant, the other a seasoned patron—we see some marked variations in sequence package design. However, regardless of which parsing structures appear in the online posting, one should note that sequence packages always emerge indigenously as features of the *locally* achieved order of natural-language website postings, whatever the variations in their design. By paying attention to these fine points, such as the posture of the "opening endorsement" and what it clearly conveys about the reviewer's status in the virtual community of online-opinion makers, a program would be better able to interpret/process the ensuing review.

All in all, mining programs that are directed to look at sequence package data for extracting some of the more subtly reported opinion-related information may prove quite useful to the mobile user. After all, why shouldn't a mobile user who doesn't have the luxury of reading through all the postings be forewarned about the downside to this major restaurant fixture in San Jose? Sandwiches falling apart, the long lines to get into the restaurant, a paucity of indoor seating, parking difficulties, and

their failure to take credit cards, are just a few of the negative features that may be extracted from these postings. This is not to say that mining programs should slant their findings toward negativity. According to the reviews, the Falafel Drive-In's food is by and large exceptionally good, which is certainly important for the mobile user to know. But the restaurant's less attractive features are also important in helping the mobile user to make an informed decision about stopping in for a falafel and shake while on-the-go.

While the two examples above explored how *negative* attributes may be hidden in online postings, the next section will show how *positive* attributes of an enterprise may be similarly hidden in user-generated content.

Finding the Hidden Positive Attributes in Online Consumer Reviews

Using as a data sample an online review of a New York City hotel, I show how hidden positive attributes may be extracted from such a review. The review had: (1) a critical review headline; (2) a weak rating score; and (3) some strongly pejorative descriptions of the consumer's experiences at the hotel. Nevertheless, the review also suggested some of the more desirable features of this hotel—desirable location, good air conditioning in the room, a spacious room with a very comfortable bed, a good discount on room rates, and very quick access to elevators. Those features were buried in this ostensibly negative review. For mobile users, in a rush to find a decent hotel in New York City, a program that could extract the *positive* attributes from this online posting (such as a good room size, comfortable bed, etc.), despite its appearance as a *negative* review, would be very helpful to a user in making the right decision.

Applying the same approach as I did with the analysis of the San Jose restaurant reviews, this section examines the sequence package design-features that emerge in situ in the online posting about the New York City hotel.

For the purpose of exploring sequence package arrangements that show the hidden positive attributes in online reviews, it really doesn't matter whether we draw on consumer reviews of restaurants, hotels, vacation resorts, car rental companies, cell phone services, or any other kind of consumer product or service; the sequence-package parsing structures are generic features of natural-language communications. They can be found across most, if not all, subject domains. It is their domain-independence, as pointed out earlier, that allows their transferability from one contextual domain to another. However, in contrast to restaurant reviews, hotel reviews may entail a lower occurrence of positive-endorsement parsing structures that show agreement with the favorable reviews of prior reviewers. The reason for this is that most hotel reviewers, unlike restaurant reviewers, are simply "passing through" an area on business or vacation, which means they are not as likely to feel peer pressure to concur in the opinion of the other online reviewers—as we've seen, from the examples above, where a reviewer is a permanent member of a (virtual) community (such as a resident of San Jose). The only cases in which this distinction

may *not* apply occur when hotel guests make a certain geographic spot their regular vacation destination. In such cases, the reviewers may tend to behave as permanent members of their (virtual) community of peers, rather than as onlookers. This would produce a higher rate of positive endorsements in their reviews, because as "permanent" community members they are understandably less eager to disagree with their fellow community members' previously published online reviews.

Example

Below is the unedited text of a consumer review posted to TripAdvisor. The reviewer's punctuation, including the use of elliptical dots, is represented below just as it appears in the online posting.

TripAdvisor

The New York Helmsley
(Manhattan)

"Poor customer service"
Reviewed 21 July 2012 (3-star rating)

Good location, but currently being renovated so you will have to excuse the untidy appearance of the hotel and the downstairs/reception area. I think this is probably reflected in the current price. Rooms are spacious, air conditioning effective and the beds very comfortable. However, I must admit to being a little disappointed by the attitude of the staff, which was churlish at best. When being dropped off outside the hotel. I found myself subjected to a fairly aggressive verbal assault from the taxi driver who seemed to think the tip I had offered was insufficient. At this point the bell boys (engaged in conversation with other cab drivers and passers by) made no attempt to intervene or help us with our bags. Would this have happened at other NYC hotels I have stayed at - I think not. Didn't get much better at check in. So all in all, not great first impressions. Elevators are very quick though....

Sequence Package Parsing Structures
<Compliment/Attenuation>
Good location, but currently being renovated so you will have to excuse the untidy appearance of the hotel and the downstairs/reception area.
<Post-Attenuation Analysis>
I think this is probably reflected in the current price
<Compliment/Attenuation>
Rooms are spacious, air conditioning effective and the beds very comfortable. However, I must admit to being a little disappointed by the attitude of the staff, which was churlish at best.
<Expansive Narrative Complaint>
When being dropped off outside the hotel I found myself subjected to a fairly aggressive verbal assault from the taxi driver who seemed to think the tip I had offered was insufficient. At this point the bell boys (engaged in conversation with other cab drivers

Fig. 5.6 Contrastive pairs found in New York Helmsley hotel review, consisting of two compliment/attenuation pairs and one negative endorsement/concession pair

and passersby) made no attempt to intervene or help us with our bags. Would this have happened at other NYC hotels I have stayed at - I think not. Didn't get much better at check in.
<Closing Negative Endorsement/Concession>
So all in all, not great first impressions. Elevators are very quick though....

Analysis

As shown in Fig. 5.6 above, this review contains three contrastive pairs. The first two consist of compliment/attenuation pair types, and the third consists of a negative endorsement/concession pair.

However, in contrast to the examples of the restaurant reviews presented above, the second pair parts, as shown in this current example, do not consist of disclaimers—which serve to withdraw, cancel or nullify the first part of the pair—but, instead, of both attenuations and concessions that do not entirely negate the import of the first pair part, serving rather to alloy or lessen its potency. As such, the reviewer's act of following his positive assessment of the hotel ("good location") with an attenuation ("but currently being renovated so you will have to excuse the untidy appearance of the hotel and the downstairs reception area") didn't invalidate the reviewer's positive assessment but rather weakened it instead. Had the reviewer said something like, "good location at the center of town but the noise is bothersome, making it really difficult to sleep at night," that would have consisted of a disclaimer rather than an attenuation because it would have struck right at the basis of the compliment.

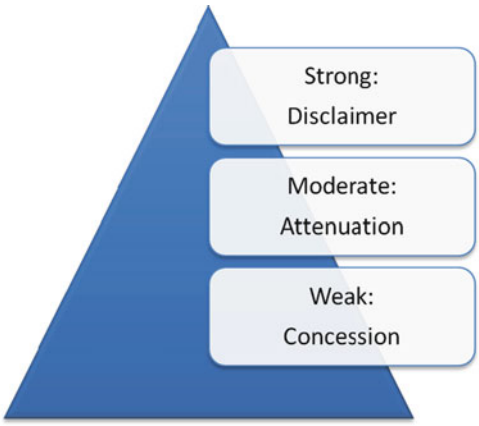

Fig. 5.7 Hierarchical arrangement of the interactive import of the second pair part in negating or diminishing what has been produced by the first pair part

In short, the main difference between disclaimers and attenuations or concessions is that while the disclaimer strikes *topically* at the first pair part head-on, in an attempt to nullify it, the attenuation or concession strikes *more generally than topically* at the source of the first part of the contrastive pair. Moreover, it doesn't much matter whether the first pair part is a complaint, as we saw in the reviews of the San Jose restaurant above, or a compliment, as we see in the present example of a New York City hotel review. For that matter, the first pair part could be any speech act, and the presence of an attenuation as the second pair part will primarily serve to weaken or lessen, as opposed to canceling or nullifying, what appears in the first pair part.

Such contrastive pairs may be arranged in a hierarchical structure based on the relative strength of the second pair part, as shown in Fig. 5.7 above. A disclaimer, which serves to directly challenge what has been produced in the first pair part (that is, to pose a challenge on the same topic that was the subject of the first part), would be rated as stronger than an attenuation or concession.[5] Figure 5.7 also shows that concessions appear even lower in the hierarchy than attenuations because they are weaker. As explained below, a comparative analysis of the sequence package arrangement of the parsing structures found in both attenuations and concessions

[5] There are occasions when the second pair part of the compliment/attenuation contrastive pair, although not a direct topical challenge to the first part of the pair, might appear strong in content even though the interactive import is still weak. For example, a person might say, "The hotel room service was exquisite though the air quality was so poor I had an asthmatic attack and had to be rushed to the hospital." In such an extreme case the second pair part is so off- topic that what would usually follow is an addendum to the contrastive pair which would try to resolve the incongruity between the parts. Sometimes humor is invoked, as in "Go figure, you get this great room service but you end up in the hospital from pollution!" Using the SPA approach to analyze natural-language communications, one would look for the sequentially-implicative units in this example. The criticism – although it entailed alarming content (landing in the hospital) – would lack potency to "disclaim" or negate the source of the compliment (which is about good room service), since its incongruence with the first pair part means it doesn't strike topically at the source of the compliment. It is therefore considered interactionally "weak" even though the content, taken outside of the sequential arrangement, might make it appear strong.

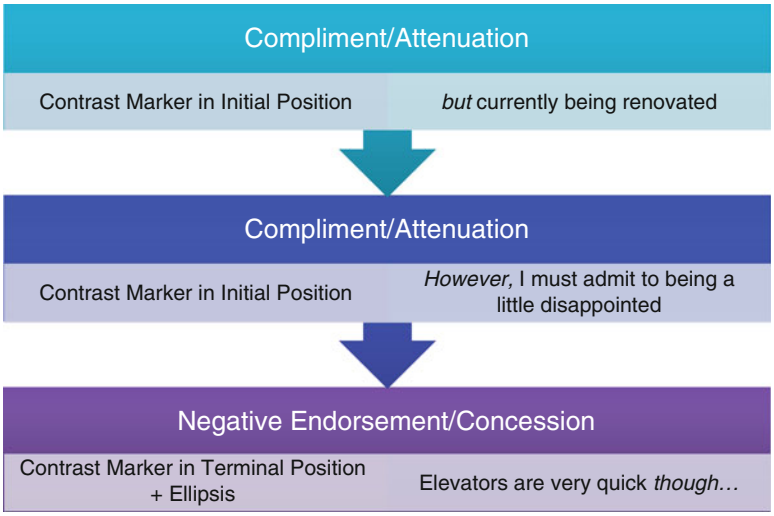

Fig. 5.8 Sequential placement of parsing structures of contrastive pairs

helps to explain the difference in the effectiveness of the second pair part in lessening what has been produced by the first pair part.

Figure 5.8 above shows the sequence-package parsing-structures appearing in the TripAdvisor review of the *New York Helmsley* that help to distinguish between an attenuation and a concession. For the purpose of this analysis, I am concentrating on the more elemental units of these sequence packages—namely, the *contrast marker* ("but", "however," and "though") and the *ellipsis* in the form of three dots (…)—upon which larger sequence package parsing structures are built.

When examining the contrast marker, what becomes important to note is the *sequential placement* of the contrast marker and not its syntactic form. In both the compliment/attenuation pairs, as seen in Fig. 5.8, the contrast marker can be found in *initial* position, which serves to introduce the attenuation which constitutes the second part of the compliment/attenuation contrastive pair. In contrast, in the (closing) negative endorsement/concession pair, the contrast marker is found in *terminal* position, following the concession, which serves to *retrospectively* create a downgrading or diminution of the negative endorsement.

In general, in gauging how strongly a speaker or writer feels about a particular topic (itself a specialized area known as "sentiment analysis"[6]), SPA pays particularly

[6] The body of research that explores reviewer attitudes in great detail is known as "sentiment analysis." Dahl (2013) explains that "[t]he goal of sentiment analysis is to characterize the speaker or writer's attitude toward the topic of the text. As reviews of products and businesses proliferate on the Web, companies that are interested in monitoring public attitudes about their products and services are increasingly turning to automated techniques such as sentiment analysis to help them identify potential problems. Sentiment analysis tries to classify texts as expressing positive, negative, or neutral sentiments, and can also look at the strength of the expressed sentiment" (p. 63).

close attention to whether a contrast marker appears in initial position, introducing the second part of the contrastive pair, or in terminal position, immediately following the second part of the contrastive pair. When contrast markers appear in initial position, as opposed to terminal position, they have a much stronger effect in negating what has occurred immediately before the contrast marker is produced, whether it is the work of complaining, complimenting, endorsing, etc. The opposite side of the coin is also true: when the contrast marker appears in terminal position, it projects a much milder form of backpedaling than it would had it appeared at the beginning of the second part of the contrastive pair.[7]

Applying this line of reasoning to the hotel review example presented above, we conclude that the *compliment* is more strongly negated than the *negative endorsement*. This is so by virtue of the fact that the second pair part of the compliment—that is, the attenuation—begins with a contrast marker, whereas the second pair part of the negative endorsement—that is, the concession—ends, rather than begins, with the contrast marker. In addition, an ellipsis of three dots (…), which occurs immediately after the contrast marker found in the negative endorsement/concession contrastive pair ("So all in all, not great first impressions. Elevators are very quick *though* …"), further weakens the strength of the rebuttal, in that ellipses, as discussed earlier, convey unfinished thoughts; in this case the ellipsis indicates the somewhat noncommittal, uncertain posture of the reviewer, making his backpedaling even less definite. Accordingly, the presence of such sequentially-implicative units in this hotel review are not surprising, given that this reviewer is angry and upset—a fact amply demonstrated by the reviewer's expansive narrative complaint about his quarrel with the cab driver who complained about his tip, while the bellhops were too busy talking with other cab drivers and passersby to intervene or help with the luggage. But rather than depend on extracting relevant sentences from the review and from the review headline, which would have certainly brought out the reviewer's strongly negative sentiment, a good mining program must examine the sequence package arrangements in which useful hotel features (such as good location, comfortable bed, and very quick elevators) have been embedded and hidden in negative reviews. The alternation of compliments and attenuations or, in contrast, negative endorsements and concessions—which compose the sequence package parsing structures that have emerged indigenously in this review—might be a good place to begin.

[7] In Neustein (1981), the formal properties of cross-examination were closely analyzed for, among other things, the placement of summary contrastive facts (referred to as "contrast formulations"). The author found that the projective force of an examiner's question on the witness's next turn was occasioned by the placement of the contrast marker. It followed that stronger contrast formulations, marked by contrast markers in initial rather than terminal position, occasioned a denial from the witness, as opposed to an admission or partial concession to the attorney's accusation.

Conclusion

Review-summarization programs that mine user-generated content for opinion-related information may benefit from a close analysis of the sequence-package design of online postings. The reason is that online reviewers, like other social interactants engaged in the situated production of social order, build their reviews in situ. In so doing, they demonstrate in their blog postings the situated achievement of social order within the virtual community of online reviewers, which entails, in part, their continual negotiation of their status, role and placement within that community. Since this process is dynamic, rather than fixed, SPA offers a new natural-language understanding method which identifies the hidden attributes of reviews (attributes that, though hidden, are valuable to mobile users) by means of sequence package parsing structures that emerge indigenously as features of the *locally* achieved order of natural-language website postings. What is more, SPA's domain-independence (as well as its language-independence) render it suitable for broad application to user-generated content, not only to consumer reviews. This chapter introduces SPA as an innovative natural-language understanding method that can assist human translators in building a corpus of annotated-training data, and can eventually assist in the replacement of human annotators (supervised learning) by SPA-designed machine learning.

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