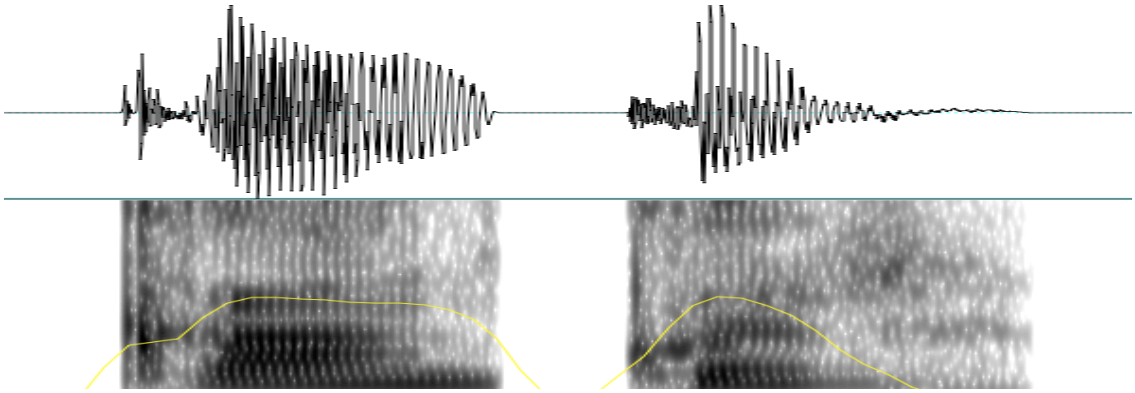
Master's Thesis

Emotion and the Perception of Loudness in Speech



An examination of whether emotional reactions to certain words can affect how loud they are perceived to be.

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i. Abstract

This study investigates interactions between the emotional content of spoken language and the perception of a subjective auditory sensation, loudness. Specifically, I examine whether or not a listener's emotional reactions to certain words can modulate how loud that word is perceived to be.

While loudness may seem to be an acoustic property, the intensity of a sound does not necessarily correlate with its perceived loudness. Certain speech sounds, for example, may differ in intensity by up to 5 decibels and nevertheless be perceived as equally loud. Research has demonstrated that emotional reactions to linguistic and non-linguistic stimuli may modulate perception in a number of ways, such as making hills seem steeper or coins seem larger. Recent experiments suggest that the perception of loudness can be magnified in response to negatively conditioned auditory stimuli; however it is yet unknown whether negative emotional content in language may elicit similar effects. Such an effect seems plausible given numerous findings suggesting that emotional content in language may modulate perception as well as neurobiological evidence suggesting that the amygdala, which has been strongly implicated in the processing of emotion, may affect neural activation in the auditory cortex.

To test this hypothesis, an experiment was conducted in which participants were tasked with comparing the loudness of two words. Results suggest that listeners perceive swear words to be louder than comparable neutral words and in contrast to the neutral control stimuli this effect cannot be attributed to acoustic factors. However, the results must be treated with caution as phonemic factors between the stimuli may have influenced responses. A mechanism for increasing the loudness of certain auditory stimuli may reflect general evolutionary biases in attention towards sensory stimuli that are relevant to the observer, e.g. threat detection. While the possible influence of confounding factors cannot be entirely ruled out, this study provides a solid foundation for future research into this phenomenon

Key Words: Loudness, emotion, speech perception, auditory perception, swear words, attentional capture.

ii. Acknowledgments

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Table of Contents

1. Introduction

Psycholinguistic research into the perception of spoken language has demonstrated that the acoustic signals that reach our ears do not necessarily match up with the final interpretations in our brain. If listeners are presented with an ambiguous sound half-way between a /t/ and a /d/, followed by "-ash," they are more likely to report that they hear "dash," a meaningful English word, than "tash," a nonsense word. However, if that same ambiguous sound is followed by "-ask," listeners are more likely to report that they hear "task" than " dask" (Ganong, 1980). Thus the meaning (or lack thereof) of a word can alter the way it is perceived; that is, the same acoustic signal is perceived differently according to how the interpretation of that signal fits with the perceiver's linguistic knowledge.

But is it possible that top-down processes related to language might also affect the perception of other acoustic properties, such as intensity? This study investigates a single auditory sensation, loudness, with regard to its perception in spoken language. Specifically, whether or not a listener's emotional[1] reactions to certain words can modulate how loud those words are perceived to be. Dess & Edelheit (1998) provide some of the first experimental evidence suggesting that loudness perception may interact with emotional factors. These researchers asked participants to rate the loudness of tones presented at four intensity levels, exposing half the participants to a stressor (unexpected air horn burst) during a word-unscrambling task prior to the rating phase. In the stressor condition, individuals who were assessed as having high trait arousability rated the tones as

[1] The exact distinction between affect and emotion is not necessarily clear. Affect generally refers to broad physiological states or reactions that are valenced (positive/negative), while emotion generally refers to more specific social constructs (e.g. anger, happiness). As these meanings often overlap in many cases the terms are used interchangeably.

significantly louder on average than those with low trait arousability, suggesting that stress had magnified these individuals' perception of loudness. Subsequent research suggests that inducing a negative emotional state (Siegel & Stefanucci, 2011) or negative conditioning in response to a particular sound (Asutay & Västjäll, 2012) may also influence loudness estimations.

However, it is yet unknown whether emotional reactions to words with pre-existing negative affective or social associations, such as swear words, are also capable of inducing "loudness magnification." This study investigates whether emotional reactions to aversive linguistic stimuli can magnify the perception of their loudness. In order to examine this, an experiment was conducted comparing individuals' perceptions of loudness in neutral words and swear words. Van Lancker & Cummings (1999) define swearing as "the use of deistic, visceral and other taboo words and phrases" (pp. 83). In contrast to words that denote specific objects or ideas, swear words primarily express or convey the emotional state of the speaker (Jay & Janschewitz, 2008). Though not uncommon in everyday conversation (Cameron, 1969), swear words elicit greater physiological reactions than comparable neutral or even euphemistic words (Bowers & Pleydell-Pearce, 2011) and have been used in a number of experiments as negative emotional stimuli (e.g. Zeelenberg & Bocanegra, 2010; Bertels, Kolinsky & Morais, 2010).

In addition to behavioral findings indicating that perception can be influenced or modulated by affect, I also discuss how this phenomenon can be grounded in what is known about the structure and function of neural systems. As perceptual and attentional resources are finite (Vuilleumier, 2005; Mather & Sutherland, 2011), the function of a

loudness magnification mechanism may be to draw attention to certain biologically, socially or personally relevant auditory sensations in our environment.

2. Emotional effects on perception

The recognition that emotion has the potential to influence perception has gained a great deal of ground in recent years (e.g. Pessoa, 2010; Zadra & Clore, 2011; inter alia…). Within this domain, it has been found that both global emotional states, e.g. moods, and specific emotional reactions, e.g. appraisal and evaluation of specific objects, can modulate perception. For example, the experience of fear or anxiety can modulate how steep a hill appears to be; research has found that observers consistently report that the slant of a hill appears steeper from the top than from the bottom (Proffitt, Bhalla, Gossweiler, Midgett, 1995). This effect is attributed to the fact that standing at the top of a hill introduces the possibility of falling, and thus increases the precariousness of the situation. To test this, Stefanucci, Proffitt, Clore, and Parek (2008) conducted an experiment in which participants standing at the top of the hill were asked to estimate its steepness; half of the participants stood on a sturdy wooden box, while the other half stood on a skateboard with braced wheels. Although the skateboard was rendered immobile, the possibility that it might roll down the hill was judged to render the situation more precarious for those participants. Results found that the skateboard participants judged the slant of hill to be significantly steeper than those who stood on the box.

In addition to perceptual modulation due to emotional state, various studies have found that the affective significance or relevance of an object to the observer may modulate an observer's conscious perception of that object. One of the earliest such studies,

conducted by Bruner & Goodman (1947), investigated possible interactions between affect and the perception of size. Children were tasked with estimating the size of circular objects by manipulating a mechanical iris in order to increase and decrease the diameter of a circle of light. All children were found to overestimate the size of coins, but this effect was greater for the children from low-income homes. Yet when presented with brown discs of paper equal in size to the coins, the children accurately estimated the size of the objects. From this the researchers concluded that the magnification of the coins was a product of the children's affective response, in this case desire, to the money. Similar "desire" responses have also been observed in adult dieters' estimations of the size of food (Van Koningsbruggen, Stroebe & Aarts, 2011).

2.1 Emotional Effects on Auditory Perception

Interactions between affect and perception are not exclusive to the visual domain; emotional reactions to both speech and non-speech have also been found to influence auditory perception. Bertels, Kolinsky & Morais (2010) investigated enhanced spatial awareness following exposure to negative and taboo words. This study utilized an auditory variant of the dot-probe task in which rather than visually presented dots, auditory "beeps" were presented from one of two loudspeakers located to the left and right of a seated participant. Stimuli consisted of neutral, negative and taboo words (e.g. "bamboo," "massacre," and "shit"). Participants were found to correctly identify the presence of a beep faster when its location was preceded by presentation of a taboo word rather than a neutral word (Experiments 1 and 2); when the task was to locate the source of a beep (left

or right speaker), participants accurately identified the location faster when the beep was preceded by a negative or taboo word from the same location[2].

As visual magnitude ("size") may be magnified in response to certain objects (Bruner & Goodman, 1947; Van Koningsbruggen, Stroebe & Aarts, 2011), recent findings suggest that the auditory correlate of magnitude, i.e. loudness, may also be affected in a similar fashion. Asutay & Västjäll (2012) tested the perception of loudness in response to negatively conditioned auditory stimuli; in this study, participants rated the loudness of four white-noise samples (1/3 octave band pass noise, 5.5 seconds long with center frequencies of 250Hz, 500Hz, 1kHz, and 2kHz) along a visual analog scale (VAS). Prior to rating, each participant underwent a negative conditioning phase in which a "moderately unpleasant tactical stimulation (vibration applied to the chair)" was introduced immediately following presentation a certain stimulus (pp. 2). In half the participants, the conditioned stimulus (CS+) was the 250Hz sample, while for the remaining participants CS+ was the 2kHz sample. The unconditioned stimuli (CS-) served as control items to facilitate between-group comparisons. During conditioning, electrodermal activity (EDA) was recorded as a measurement of participant arousal and thus an indicator of conditioning. Results found that participants in both groups consistently judged CS+ stimuli to be louder in comparison to the respective CS-. Mean loudness rating for the 250Hz sound was 0.124 when this sound was the CS+, but -0.598 when CS-; mean loudness rating for the 2kHz sound as CS+ was .187 and -.308 as CS-. As the stimuli were identical for both groups,

[2] This effect, however, was only found with regard to cases in which both the beep and the taboo word came from the right speaker; the authors attribute this finding to the strong lateralization of language processing to the left hemisphere, where sounds from the right ear are first processed.

this increase in loudness judgments cannot be attributed to any acoustic factors and thus must reflect the negative, psychological associations induced during conditioning.

3. Neurobiological Basis

Arguing that emotion can modify perception is in effect making a claim about how top-down neural processes might affect sensory areas of the brain. Therefore, to adequately substantiate such a claim it is important to consider how the architecture and processing functions of the brain may support emotional-perceptual interactions, specifically loudness magnification. The amygdala[3] occupies a particularly prominent place in the research literature due to its heavy involvement in the processing of emotion (LeDoux, 1992; Phelps & LeDoux, 2005). Activation of the amygdala has been found with regard to a host of emotion-related functions including recognition of specific emotions, e.g. fear (Fendt & Fanselow, 1999; Barrett, Bliss-Moreau, Duncan, Rauch, & Wright, 2007) and anger (Scott et al., 1997), the processing of positive emotion and reward (Murray, 2007), and the regulation of emotion (Amorapanth, LeDoux & Nader, 2000) and attention (Ghallagar & Holland, 1994). As this region seems particularly relevant to loudness magnification, rather than attempt to discuss the neurobiology of emotional-perceptual interaction in its entirety I focus specifically on the amygdala and its interactions with sensory processing and language.

[3] It is important to note that the amygdala is not a discrete unit. "The amygdaloid complex, located in the medial temporal lobe, is structurally diverse and comprises 13 nuclei. These are further divided into subdivisions that have extensive internuclear and intranuclear connections" (Sah, Faber, Lopez de Armentia, & Power, 2003, pp. 804-805). In the literature, however, "amygdaloid complex" is not as common and even Sah et al. use the two terms interchangeably. Therefore for ease of reference, "amygdala" is used in this study.

3.1 Involvement of the Amygdala in Perception and Language

The left amygdala in particular has been implicated in the processing of verbally conveyed emotion. Utilizing event-related functional magnetic resonance imaging (fMRI), Strange, Henson, Fristan & Dolan (2000) measured blood-oxygen levels in specific regions of the brain in response to visually presented lists of words. Each of these lists consisted of semantically related control nouns, as well as three distinct "oddball" nouns present in each list: a semantic oddball, in which the meaning of the word did not match the general semantic pattern of the list (e.g. the word "clarinet" in a list of nouns related to cleaning supplies); a perceptual oddball, in which the font of the word was distinctly different; and an emotional oddball, i.e., a word relating to the general meaning of the list but carrying a strong, negative emotional connotation (e.g. "poison" in a list of cleaning supplies). Relative to controls as well as semantic and perceptual oddballs, emotional oddballs led to greater levels of activation in the amygdala and the left inferior frontal cortex. In addition, participants were significantly better at recalling emotional oddball nouns than control nouns. Based on these results, the authors propose that the left amygdala is involved in the encoding and recall of "emotionally aversive" nouns (pp. 431).

The amygdala has also been specifically implicated in enhancing perception in response to emotional words. Anderson & Phelps (2001) examined this phenomenon with individuals suffering from damage to the amygdala, utilizing the attentional-blink effect[4] (Raymond, Shapiro & Arnell, 1992), The task of the participants was to attempt to identify and remember two green-colored words (T1 and T2) embedded within a rapid serial visual

[4] This is an attentional effect in which identifying a certain target (T1) impairs detection of a subsequent target (T2) during RSVP. However, this effect is diminished if T2 constitutes a negative emotional stimulus (Anderson, 2005).

presentation (RSVP) of black-colored distractor nouns. The conditions of the task were varied according to the length of time between presentation of T1 and T2 (*lag*) and the valence of the T2 word. Participants included 20 healthy control subjects, 10 persons with "unilateral lesions to the left or right amygdala" (5 left, 5 right; pp. 306) and one person suffering from bilateral amygdala damage. Controls were found to be more accurate at identifying negative-valence words than neutral words, and the effect of the enhancement was greater when lag between T1 and T2 was short. The same enhancement for negative words was also found for participants with damage to the right amygdala, whose accuracy scores did not differ significantly from controls. However, participants with damage to the left amygdala (and bilateral damage) did not show any identification advantage for the emotional words. The authors suggest that these lesions to the amygdala "disrupt its ability to modulate the efficiency of word processing that takes place in other brain regions" (pp. 308). However, these results also support Strange et al. (2000)'s assessment of the amygdala as being directly involved in the encoding of emotional linguistic material. In either case, it is clear that damage to the left amygdala appears to disrupt enhanced perception and retention of emotional words.

3.2 Neural Locus of Loudness.

As FMRI activation in the auditory cortex (AC) has been found to correspond more closely with perceived loudness rather than acoustic intensity, it is likely that this area of the auditory system is responsible for the perception of loudness (Langers, Dijk, Schoonmaker & Backes, 2006). This is supported by research into neural activation at different stages of auditory processing; auditory information is transmitted from the cochlear nerve (CN) to the AC via the inferior colliculus (IC) and the medial geniculate

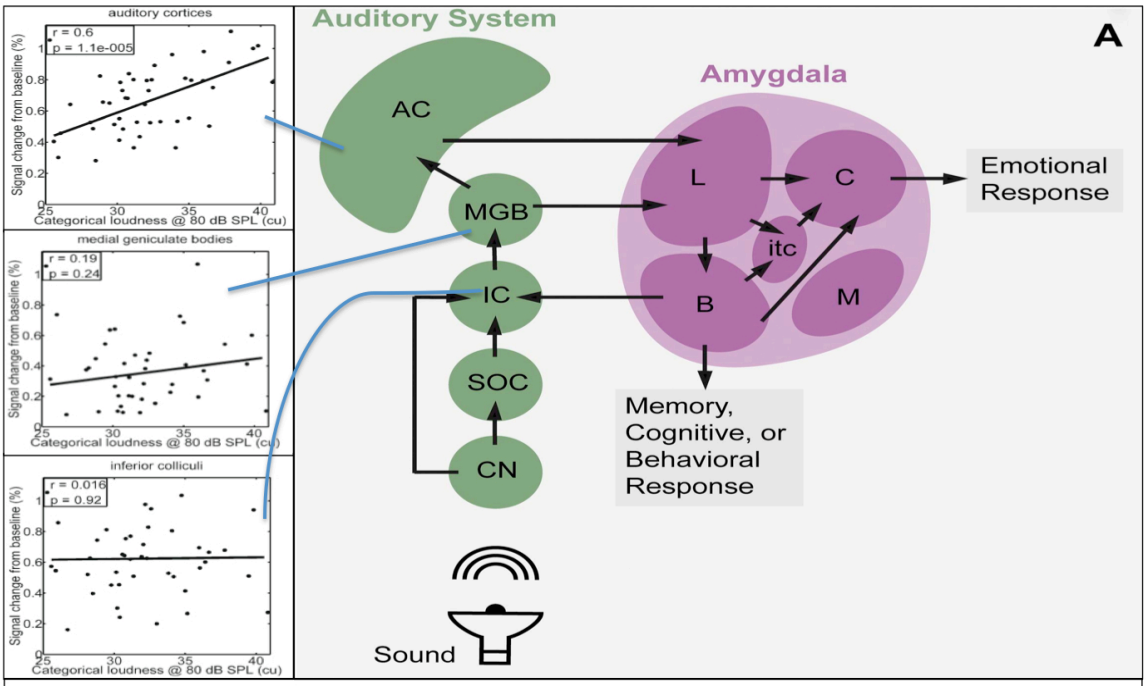

Figure 1. Anatomical correlates of loudness and interactions with amygdala. Graphs on left represent neural activation as a function of categorical loudness perception for the inferior colliculi (IC), medial geniculate bodies (MGB), and auditory cortices (AC; Röhl & Uppenkamp, 2012). Black arrows represent the flow of acoustic information transmitted via the cochlear nerve (CN) to the superior olivary complex (SOC), IC, MGB) and AC. Afferent connections from the basal amygdala (B) to the IC and from the AC to the lateral amygdala (L) create a feedback loop (Kraus & Canlon, 2012, pp. 36). As loudness perception appears to be a function of the AC, such a feedback loop could influence loudness perception from an early stage of auditory processing.

bodies (MGB). While neural activation in the IC, MGB and AC increases linearly in response to increases in the intensity of an auditory stimulus, only in the AC does this increase correspond to a listener's subjective perception of loudness (Fig. 1, left boxes; Röhl & Uppenkamp, 2012).

3.3 Interactions between Amygdala and Auditory Cortex

A final issue to consider is how interactions between the amygdala and the auditory processing centers of the brain may modulate perception, and specifically, how this might magnify the loudness of certain auditory stimuli. The amygdala has a relatively high number of connections to other neural areas, including sensory systems (Sah, Faber, Lopez De Armentia, & Power, 2003), which singles it out as having a "strong potential for

integrating cognitive and emotional information" (Pessoa, 2010, pp. 435). For example, the amygdala both receives and sends information to the visual cortex; incoming information arrives via the amygdala's

lateral and accessory basal nuclei, while outgoing information is transmitted via the basal nucleus to multiple locations in the visual cortex (VC; Freese & Amarel, 2005). Examination of the neural structure of macaque monkeys reveals that the amygdala has connections to the cortical, intermediate and rostral areas of the auditory cortex (Yukie, 2002).

It has been suggested that afferent and efferent connections between the amygdala and sensory cortices may form "feedback loops" (Pessoa, 2010); Hupe, James, Girard & Bullier (2001) have proposed that through these loops the amygdala might modulate sensory processing by enhancing neural responses. With regard to auditory perception, there exists (in humans) such a feedback loop between the amygdala and the AC via the IC (Fig. 1; Kraus & Canlon, 2012). Therefore it is possible that amygdalar activity in response to affective stimuli may via this loop lead to increased activation in the AC.

These feedback loops have also been proposed to drive changes in neural plasticity in response to sensory stimuli, as in the case of fear conditioning (Armony Quirk & LeDoux, 1998; Fendt & Faselow, 1999). Weinberger (2004) suggests that in the case of auditory fear conditioning, the amygdala may induce changes in the neural plasticity of tonotopic maps[5] in the AC. Regarding Asutay & Västjäll (2012)'s results suggests that the perception of loudness can be magnified in response to a negatively conditioned stimulus, it is possible that such changes in tonotopic plasticity might underlie this effect.

[5] Tonotopic maps refer to spatial grouping in the auditory system of neurons sensitive to specific frequencies. This may be compared to how different areas along the basilar membrane are more sensitive to certain auditory frequencies.

4. Experimental Method

To reiterate, neurobiological and behavioral evidence points to a great deal of interaction between affect, perception and language. In light of research demonstrating that affective states and reactions can magnify the perception of loudness (Dess & Edelheit, 1998; Siegel & Stefanucci, 2011; Asutay & Västjäll, 2012), it is likely that the affective content of language may also induce comparable effects. Words with strong negative emotional and social connotations, such as swear words, have been consistently found to modulate perception (e.g. Anderson & Phelps, 2001; Zeelenberg & Bocanegra, 2010; Bertels, Kolinsky & Morais, 2010) and therefore represent the most appropriate candidates for causing loudness magnification. This is even more likely given that (absent of any conditioning) EDA activity that has also been found in response to swear words (Bowers & Pleydell-Pearce, 2011) is comparable to the EDA activity recorded by Asutay & Västjäll (2012) during the conditioning phase of their experiments on loudness perception. To test this hypothesis, this experiment investigated whether participants perceived swear words to be louder in comparison to acoustically and phonologically equivalent neutral words.

4.1 Perception of Loudness in Speech

Loudness is a subjective psychological construct that refers to the estimated magnitude of an "auditory sensation" (Fletcher & Munson, 1933, pp. 82). Like an inch or a yard, the measurement of loudness is relative to an arbitrary construct. In the decibel (dB) scale, one of the most common metrics for measuring the intensity of sound, a general reference level of 0dB SPL (sound pressure level) is roughly equivalent to the average threshold for detecting a 1kHz tone in silence (Moore, 2008). Above the level of 40 dB SPL, increasing the intensity of a tone by 10dB SPL corresponds to an approximate doubling in

the perceived loudness of a sound. However, the perceived loudness of a sound as simple as a pure tone can vary depending on its frequency. A 1kHz tone played at an intensity of 40dB SPL sounds equal in loudness to a 250Hz tone played at an intensity of 50dB SPL (Fastl & Zwicker, 1990).

In addition, extensive research has demonstrated that the perception of loudness differs for speech and non-speech sounds (e.g. Lehiste & Peterson, 1959; Schirmer, Simpson & Escoffier, 2007). Rather than reflecting acoustic intensity, the perception of loudness in speech most closely corresponds to the amount of physiological "effort" which is required to produce the sound (Ladefoged & McKinney, 1963). As the production of different phonemes requires different amounts of air pressure, the intensity of speech measured in dB can vary greatly while the listener perceives a relatively stable level of loudness. The loudness of a phoneme relative to other phonemes is known as its "intrinsic intensity" (Lehiste, 1970, pp. 120). Lehiste & Peterson (1959) compared the averaged intensities of 15 sustained English vowels (in dB); while the vowels all seemed to be equally loud to the observers, acoustic intensity between vowels varied by up to 5 dB. Vowel intensity has also been found to vary depending on the place, manner and voicing of the surrounding consonants (Blood, 1981). Recent research into the perception of loudness in common, monosyllabic words suggests that the ratio between the intensity of the consonants and the intensity of the vowels may also have an affect on how loud a word is perceived to be (Orr, Montgomery, Healy & Dubno, 2010). Despite such findings, a great deal still remains unknown about how the brain computes the loudness of normal words, which are often comprised of multiple syllables and combinations of diverse phonemes, or how the brain compares the loudness of two such words against each other. It is therefore

important that when attempting to compare such items, measures are taken to keep differences between words as minimal as possible.

For people with normal hearing the average just-noticeable-difference (JND) threshold for detecting an increase in the loudness of a speech sound is approximately 1 to 1.3dB (Lehiste, 1970; Rogers, Healy & Montgomery, 2006). Therefore if a listener is presented with Word A having an intensity of 70dB and a Word B having an intensity of 72 dB, both words being practically identical with respect to their phonetic qualities (e.g. pitch, duration, frequency) as well as the intrinsic intensity of their component phonemes, a listener should be able to correctly identify B as louder with greater than chance accuracy. If, however, Word A and Word B are presented at the same level (e.g. 70dB), these words would seem to be equal in loudness; we would therefore expect Word B to be selected approximately 50% of the time, simply due to chance. If however, a preference is found for either Word A or Word B, this preference must reflect some non-acoustic, psychological factor. Based on this principled assumption, this experiment attempted to isolate the emotional content of a word as the only possible influencing factor in loudness comparisons.

4.2 Participants

32 participants (29 female) were recruited from the Utrecht Institute of Linguistics OTS (UiL OTS) participant database for an experiment investigating how different sounds can affect the "clarity of speech." Participants were informed in the recruitment email that the experiment involved listening to different types of words, such as common nouns, greetings, exclamations, names, as well as some "vloekworden" (curse words), and comparing how loud the words seemed to be as an indicator of clarity. Age ranged from 18

to 47 (mean: 22.4, median: 21, mode: 19). All participants reported themselves as being native speakers of Dutch and having normal hearing. As reasonable accuracy in loudness judgment was deemed a necessary prerequisite for the study, a selection criterion of at least 60% correct responses to filler items was imposed. Based on this criterion, the results of two participants (both female) were excluded. All remaining participants were right-handed.

4.3 Design

The experiment employed an AB-forced choice paradigm to obtain loudness discriminations. This design was chosen in order to minimize the effects of "semantic satiation," a phenomenon in which repeated auditory exposure to a word leads to a deterioration in meaning until only sound is perceived (Lambert & Jakobovits, 1960). As the differentiating factor between the conditions in this study depended on meaning, it became a priority to minimize the possibility of satiation, especially as this effect has been found to apply more rapidly to emotionally-valenced stimuli (Prochwicz, 2010). For this reason, each word in this experiment appears with equal frequency.

The experiment consisted of a practice block of five trials, followed by two test blocks of 156 trials each. Of the 312 trials, 52 consisted of the experimental trials (26 Test items, 26 Control items) while the rest were fillers. Six pseudo-randomized lists were generated which distributed test items amongst fillers according to the following criteria: 1) maximum of two consecutive trials in the same intensity pairing (e.g. Loud-Soft); 2) for each position (First or Second) in a pair, maximum of three consecutive words from the same word list (e.g. *Neutral1* or *Confound2*); 3) for each position (First or Second), the same sound file must be separated by at least 15 trials; 4) at least 4 filler trials must separate

each of the experimental trials. In every list, each word appears four times as the first word in a pair and four times as the second.

4.4 Materials

This study utilized 78 Dutch words grouped into three lists of matched pairs. All neutral and most swear words were drawn from the top 500 most frequent words in the Corpus of Spoken Dutch (CGN; Eerten, 2007). In addition, several swear words not present in the corpus were added after personal consultation with native speakers. Where possible, pairs differed by only a single phoneme (e.g. “kanker ~ kanjer”). While this was not possible in all cases (e.g. “flikker ~ kikker"), no pairs differed by more than two phonemes.

Even though phonetic parameters such as pitch, duration and amplitude were controlled by means of speech synthesis (described below), it remained a possibility that phonemic differences between the minimal pairs could influence participants’ perceptions of loudness due to differences in intrinsic intensity. While it would have been ideal to utilize minimal pairs in which the differentiating phonemes were equal in terms of intrinsic intensity, such control was not possible. This was in part due to the fact that the number of minimal pairs for the swear words was limited by the lexicon, and also in part due to the lack of a single, clear metric for measuring the intrinsic intensity of speech sounds in complex words.

In the absence of definitive methods for determining the intrinsic intensity of a word or its component phonemes, a heuristic was required for choosing the most suitable minimal pairs from possible candidates. “Relative Sensation Level,” (RSL) is a concept developed by Fletcher (1953) that represents the “power” of speech sounds relative to each other (Fig. 2). It is the average two separate measurements; 1) “Threshold,” which

refers to the number of decibels that a "sound must be attenuated to make it inaudible" (pp. 84), and 2) "Articulation," which refers to the amount of attenuation needed for a sound to become "misunderstood some arbitrary percent of the number of times uttered" (pp. 83). For example, the vowel /e/ in "tape" needs to be attenuated by 93.3 dB to become inaudible (Threshold), and by 98.2 dB to be misunderstood a certain number of times (Articulation), giving it an RSL of 95.8. In contrast, the /i/ in "team" has a Threshold of 89.4 and an Articulation of 96.3, giving it an RSL of 92.9. Using this metric, it became possible to assign to each phoneme a numeric value and thus choose minimal pairs in which the difference in RSL was minimized[6].

Relative Sensation Levels Produced by an Average Speaker for the Fundamental Speech Sounds

Speech Sound	Threshold	Articulation	Average
ó (talk)	100.0	100.0	100.0
o (ton)	99.6	100.0	99.8
ō (tone)	99.6	98.9	99.3
ī (bite)	99.5	100.0	99.8
ou (bout)	99.2	100.0	99.6
á (tap)	99.2	97.2	98.2
e (ten)	98.4	93.5	95.9
a (top)	97.4	100.3	98.9
u (took)	97.1	98.1	97.6
ū (tool)	95.9	94.3	95.1
ā (tape)	93.3	98.2	95.8
i (tip)	92.6	95.5	94.0
ē (team)	89.4	96.3	92.9
r (err)	96.0	95.5	95.8
l (let)	93.5	92.6	93.1
ng (ring)	88.9	93.8	91.4
sh (shot)	88.9	93.2	91.1
ch (chat)	87.2	89.7	88.5
n (no)	86.8	86.7	86.75
m (me)	85.4	85.1	85.3
th (that)	84.2	.....	84.2
t (tap)	84.1	86.4	85.3
h (hat)	83.9	81.7	82.8
k (kit)	83.8	85.3	84.6
j (jot)	83.7	89.7	86.7
f (for)	83.6	77.7	80.7
g (get)	82.9	86.9	84.9
s (sit)	82.4	78.1	80.3
z (zip)	81.6	81.6	81.6
v (vat)	81.4	80.1	80.8
p (pat)	80.6	81.4	81.0
d (dot)	78.9	87.8	83.4
b (bat)	78.8	83.7	81.3
th (thin)	78.7	71.2	75.0

Figure 2. Relative Sensation Levels (RSL) for English Speech Sounds (Source: Fletcher, 1953, pp. 85). The first column represents various English speech sounds. The second column, "Threshold," represents the degree to which each sound must be attenuated (values in decibels) in order to render it inaudible. The "Articulation" column reports the degree to which each sound must be attenuated in order to be misunderstood a certain number of times. The fourth column gives the averages of these two measurements, and thus the "Relative Sensation Level" of a given speech sound.

4.4.1 Synthesis

In order to minimize variation in amplitude, duration and pitch, stimuli

[6] Certain sounds present in the minimal pairs were not included in Fletcher's (1953) measurements. These included the palatal glide /j/, to which the arbitrary RSL of 86.7 was assigned, and the velar fricative /x/, which was assigned the same RSL as /h/ (82.8). For two phonemes, as in the case of "flikker," RSLs were averaged.

were synthesized using Mbrola (Dutoit, Pagel, Pierret, Bataille, van der Vreken, 1996), a non-commercial multilingual text-based synthesizer that concatenates sounds from language-specific diphone databases. This program synthesizes speech from text files containing phonetic transcriptions entered in X-SAMPA notation alongside numeric values indicating the duration of phonemes as well as pitch values over time. For this project the database NL3, which simulates an adult female speaker of Dutch, was used.

First, a base version of each word was generated using the Fluent Dutch Text-to-Speech program, which takes as its input an orthographically entered Dutch word and from that generates an Mbrola file with appropriate phonemic, durational and prosodic information. To ensure that the minimal pairs were identical with regard to phonemic and overall duration, for each pair the duration of the differentiating phonemes was modified to the average of the two. According to Monique Bieman's (2000) work on vocal characteristics of Dutch speakers, an average female pitch of 217Hz was taken as the starting point for each sound file. An average declination was set at -0.55 ERB from starting frequency, resulting in a final pitch of 191Hz for all words (Heuven & Haan, 2000).

The intensity of each word was normalized utilizing Praat (Boersma & Weenink, 2011). For each word pair, the average intensity of the respective sound files was determined in decibels. The minimum loudness was taken as a baseline, and the intensity profile of each file modified so that the average intensity of each pair was equal. After this normalization, each word was synthesized at two intensity levels (for ease of reference dubbed "Loud" and "Soft"). These files were then used to contrast the stimuli and fillers.

4.4.2 Experimental Stimuli

Each experimental trial involved presentation of two words, A and B, where A is drawn from one of two word lists (Test items: *Swear*, Control items: *Neutral1*) while B is a minimal pair drawn from a corresponding list (Test items: *Neutral*, Control items: *Neutral2;* Appendix 1A). An example of a Test item is "slet~smet," ("slut~stain"), whereas an example of a Control item would be "maar~jaar" ("but~year"). Control items were added in addition to the Test items for two reasons: 1) it is possible that any selection preference for words in the *Swear-Neutral* and *Neutral-Swear* conditions is due to the different phonemes in each word rather than differences in meaning. By including cases in which difference in meaning is not a factor, it becomes possible to determine if and to what extent the phonemic differences affect loudness perception. As to the second reason, 2) in pilot tests, participants demonstrated a bias towards choosing the second word regardless of condition. Therefore rather than compare the Test conditions against a fallacious null hypothesis of 50% responses to each button, button responses for the Test items can be compared directly against the Control items.

4.4.3 Fillers

As the task of the participants was to select the louder of two words, fillers were created in which the average intensities of words in a pair did in fact differ. These were created by matching the "Loud" version of one word with the "Soft" version of another, or vice versa. Fillers were constructed as follows: For each Test and Control pair, e.g. "zeker~beker," one word was randomly selected as "Loud" ("zeker") and the other designated as "Soft" ("beker"). These pairs appear in both AB ("zeker~beker") and BA ("beker~zeker") order (totaling 52 fillers).

In order to draw attention away from the purpose of the experiment and mask the salience of the swear words, 13 Confound items (two lists: *Confound1* & *Confound2*) were created in the same manner as the Test and Control items. Confound words consisting of neutral words as well as greetings ("hoi"), exclamations ("tja!"), emotional words ("haat"), and names of famous people ("Obama"). For each pair, four fillers were constructed by varying order (AB, BA) and intensity (A = "Loud", B = "Soft" *or* "A = "Soft", B = "Loud") for a total of 52 "Confound fillers."

Finally, two sets of "random-match" fillers were constructed in which words from all the lists were randomly paired with each other (39 pairs), with A as "Loud" and B as "Soft" or vice versa. Each of these pairs appeared in AB and BA order (156 pairs). This method generated a total of 52 + 52 +156 = 260 fillers (Appendix 1B).

4.5 Task and Procedure

The experiment took place within a soundproofed room with participants seated comfortably in front of a computer monitor. Sound files were presented via headphones. Responses were recorded using a two-button box, the left button labeled "eerste" (first) and the right "tweede" (second). Orientation of the button-box was consistent for all participants.

In each trial, the task of the participant was to listen to a word pair and then select the word that seemed to be louder by pressing the appropriate button. Participants were instructed to respond as quickly as possible, but only after they had completely heard both words. Response times were measured from the offset of the second word. Button presses made before this point generated an "oeps" (oops) message on the screen and were not recorded. Successful button presses were recorded along with response time, and an on-

screen message reported to the participants which button they had selected (i.e. “first” or “second”) before moving on to the next trial. If no button had been selected after 1750ms, a “te laat” (too late) message appeared, a response time of -1 was recorded, and the program then moved on to the next trial. The amount of silence between words within a pair was set at only 200ms due to the tendency for loudness representations held in working memory to deteriorate rapidly (Schröger, 1996).

Upon completion of the listening phase participants underwent an exit interview in which they were asked to report their thoughts during testing, especially with respect to any salient aspects of the experimental files and the overall purpose of the experiment. Following this, participants completed a questionnaire (Appendix 4) which recorded personal information, such as age, birthplace, and frequency of swear word usage along a 5-point Likert scale. The questionnaire also included similar scales in which participants rated the “strength” of each swear word presented in the experiment. The entire experiment, including interview and questionnaire, required approximately 25 minutes to complete.

5. Analysis & Results

Two objects of analysis, word selection and response time, were obtained from the data. After completion of testing, it was discovered that in certain cases, the Praat script intended to equalize the average intensities of word pairs had failed to work as intended. In certain words, the parameters of the script led to mislabeling of the silent (no intensity) and sounding portions of the sound file, which in turn lead to a miscalculation of each word's original intensity. For example, in the pair “staat” (state) and “staan” (stand), the

script failed to recognize the burst following the word-final /t/ as having enough intensity to qualify as a sounding proportion when averaging the intensity of the two sound files. After the script had been modified to include the burst following the stop consonant, the difference between the average intensity of the two sound files was found to be 1.73 dB.

While not included in the original design, this opened up the possibility of examining how the relative intensity of a word in a pair might affect response time and selection, and whether such differences affected all stimulus conditions equally. To this end, a variable (*dB-Difference*) was created by taking the average intensity of the second word in a pair (file B) and subtracting from this the average intensity of the first word in that pair (file A). This indicates the intensity of the second word in a pair relative to the first; as each pair appears in both AB and BA order, this value is thus centered around zero. For two Control pairs, "weg-web" (Item 24) and "zit-zin" (Item 26), the difference in intensity was particularly large (2 dB). As the greatest difference found in the Test items was 1.19 dB, it was judged that these two items alone would most likely skew the results of the data and were thus excluded from analysis leaving 13 Target items (min. intensity difference = ±0.00, max. intensity difference = ±1.19, mean difference = ±0.39) and 11 Control items (min. intensity difference = ±0.01, max. intensity difference = ±1.73, mean difference = ±0.35).

5.1 Word Selection Results

Statistical analysis was carried out using R (R Development Core Team, 2009). In each trial, selection of either the first word or the second word was indicated via button press. Responses were coded numerically ("first" = 0, "second" = 1) and the resulting variable *Button* taken as the dependent variable for analysis. Averaged values for *Button*

indicate the relative percentage of responses towards either the first or second word; values > 0.5 indicate a preference for the second word, while values < 0.5 indicate a preference for the first. A two-tailed, one sample t-test confirms that the overall mean of *Button* (0.55) deviates significantly from a hypothetical mean of 0.5 ($t = 4.3831$, $df = 1417$, $p<0.001$). This mean indicates an overall bias to select the second word in a pair. The null-hypothesis is adapted to the overall mean of *Button* in order to take this bias into account.

The new null-hypothesis states that the mean of *Button* in each condition should not differ significantly from the overall mean. Exploratory two-tailed t-tests found that the mean for *Button* differs significantly from this value in the *Neutral1-Neutral2* (mean = 0.47, $t = 3.1395$, $df = 324$, $p<0.05$), *Neutral2-Neutral1* (mean = 0.65, $t = 3.3506$, $df = 322$, $p<0.001$), and *Neutral-Swear* (mean = 0.61, $t = 2.0053$, $df = 384$, $p<0.05$) conditions, but not in *Swear-Neutral* (mean 0.51, $t = -2.0121$, $df = 384$, $p<0.05$). These tests indicate that, contrary to the null-hypothesis, participants seemed to select certain Control items much more frequently than others. Furthermore, inspection of by-Item and by-Participant responses (Appendices 2 & 3) revealed a great deal of variation. Therefore in order to investigate these findings as well as the possible interactions with *dB-Difference,* a more detailed analysis was deemed necessary.

As the data included both categorical (*Condition*) and continuous (*dB-Difference*) independent variables and a binary dependent variable (*Button*), a regression analysis was performed by means of a generalized linear mixed-effects model fit by Laplace approximation, utilizing the function *glmer()*from the package *lme4* (Bates, Maechler & Bolker, 2011). In order to avoid the language as a fixed-effect fallacy (Clark, 1973), random intercepts for *Item* (which uniquely identifies a single word-pair in both AB and BA order)

Table 1. Summary of Generalized Linear Mixed-effects model for Word Selection.

Formula: *Button ~ 1 + dB_Difference * CondAB + (1 | SubjNr) + (1 | ItemNr)*				
AIC	BIC	logLik	deviance	
1884	1936	-931.8	1864	
Random Effects:				
Groups	Name	Variance	Std. Dev.	
Subject	(intercept)	0.16906	0.4117	
Item	(intercept)	0.13919	0.37308	
	Number of obs: 1418, Groups: *Item (24), Subject (30)*			
Fixed effects:				
	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.182	0.1793	-1.015	0.31
Neutral2-Neutral1	0.8603	0.1685	5.105	3.31E-06***
Neutral-Swear	0.5927	0.2333	2.541	0.0111*
Swear-Neutral	0.232	0.2324	0.999	0.318
dB-Difference	0.812	0.2961	2.742	0.0061**
dB-Diff : Neutral2-Neutral1	-0.572	0.4859	-1.177	0.2392
dB-Diff : Neutral-Swear	-1.029	0.408	-2.522	0.0117*
dB-Diff : Swear-Neutral	-0.8804	0.404	-2.179	0.0293*

Estimates represent logit probability of word selection. Positive estimates indicate a greater likelihood for selecting the second word in this condition.

were included in the model. Rather than fitting separate models with a single random effect for *Item* or *Subject,* a single model utilizing both *Item* and *Subject* as crossed random effects was fit in order to maximize the exclusion of random variance in the data (Quené & van den Bergh, 2008). This random-effect structure was justified by multiple likelihood ratio tests against models containing random intercepts for only *Subject* or *Item* (Baayen, Davidson & Bates, 2008).

Fixed-effects for this model included *Condition* and *dB-Difference.* The levels of *Condition*, e.g. *Neutral-Swear* or *Neutral2-Neutral1*, indicate from which list each word in a pair is from and the order in which they appear. As stated above, *dB-Difference* refers to the average intensity of the second word relative to the average intensity of the first. The results of the model are summarized in Table 1. Likelihood ratio tests between the final

model and a null model containing only random-effects indicates that the final model is a better fit for the data (df = 7, Chisq. = 45.102, $p<0.001$).

The values in the "Estimates" column are expressed in logit units[7]. These values reflect the log-transformed probabilities of selecting the second word in a pair, with positive values corresponding to hit rates greater than 0.5 and negative values corresponding to hit rates of less than 0.5 (Quené & van den Bergh, 2008). As there are only two choices in a given trial, selecting the first word or selecting the second, an increase in the probability of selecting a certain word indicates a decrease in selecting the word to which it is paired.

The model takes the *Neutral1-Neutral2* level of *Condition* as its intercept; a negative slope for the intercept (β= -0.12) indicates that the model estimates a slightly greater probability of selecting *Neutral1* in this condition than *Neutral2.* A positive slope for *Neutral2-Neutral1* (β= 0.86) reveals a significant increase in the probability of selecting *Neutral1* in this order. Similarly, a positive slope for *Neutral-Swear* (β= 0.59) indicates an increase in the likelihood of selecting *Swear* in this condition. A positive slope for *Swear-Neutral* (β= 0.23) indicates a very slight tendency to choose *Neutral* in this condition (*intercept* + 0.23 = 0.05). A positive slope for *dB-Difference* (β= 0.81) indicates that in the *Neutral1-Neutral2* condition, as the average intensity of B increases relative to A, the likelihood of choosing B increases as well. These effects are significant for *Neutral2-Neutral1* ($p<0.001$), *Neutral-Swear* ($p<0.05$), and *dB-Difference* ($p<0.01$).

[7] Logit units refer to the "the logarithm of the odds of hits: logit(P) = log(p/(1-P))" (Quené & van den Bergh, 2008, pp. 422).

Significant interactions were found between *dB-Difference* and the *Swear-Neutral* (β= -1.02, p< 0.05) and *Neutral - Swear* (β= -0.88, p<0.05) conditions, but not the *Neutral2 – Neutral1* condition (β= -0.57, p>0.05). Fig. 3 represents the direction of these interactions graphically; the position of the abbreviated points indicates the difference between the original intercept for the condition (x-axis) and the adjusted coefficient when the interaction with *dB-Difference* is taken into account. These estimates refer to the logit probabilities of selecting the second word in a pair as the loudness for the second word increases relative to the first (intensity of File B minus intensity of File A). For both Control conditions, a positive estimate confirms that as the intensity of the second word increases relative to the first, so too does the probability of selecting that word. However, for the Test conditions the slope does not strongly deviate from the original intercepts; more importantly, the negative estimates suggest that in these conditions, the model in fact estimates a decrease in the probability of selecting the second word as its relative intensity increases. These results suggest that *dB-Difference* was only relevant in the control conditions.

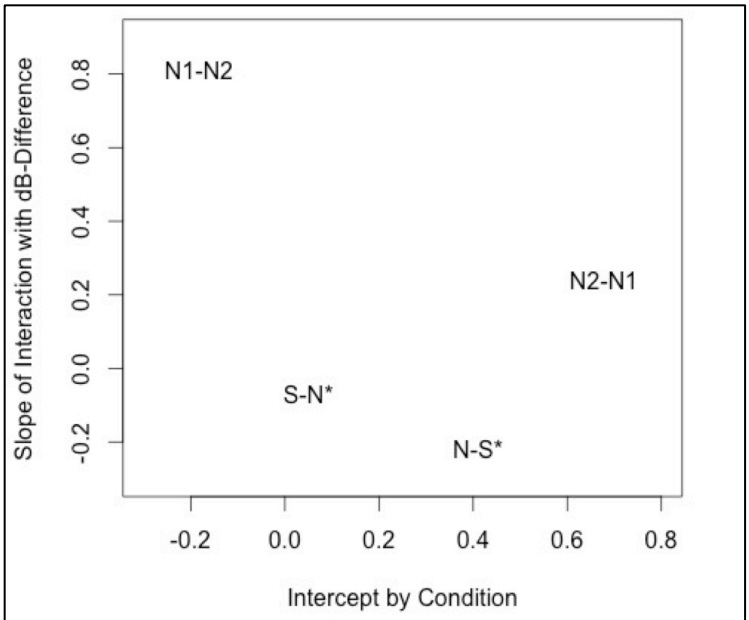

Figure 3. Interaction between *dB-Difference* and *Condition*. The slope of *dB-Difference* is indicated for each condition. Slopes for the *Swear-Neutral* and *Neutral-Swear* condition are close to or less than zero, indicating no increased likelihood of selecting the second word if it has greater intensity. Asterisks indicate these conditions remain significant after the effect *dB-Difference* is taken into account.

In addition to the final model, separate models were run for each of the participant variables obtained from the exit interview and questionnaire (Appendix 4). For the questionnaire, these variables included "Age," and "Frequency of Swear Word Usage."[8] The exit interview assessed whether or not the participant by the end of the experiment had inferred its general purpose; the result of this interview was a binary variable called "Guessed Purpose" coded as "Yes" or "No." Consecutive versions of the final model were fit with each of these variables. No significant interactions (neither two-way or three-way) were found between the fixed effects of the final model and these additional variables.

5.2 Response Time Results

Mean response times in each condition are as follows: *Neutral1-Neutral2,* 658.22ms (SD = 333.32), *Neutral2-Neutral1,* 566.04ms (SD = 293.46), *Swear-Neutral,* 645.61ms (SD = 340.58), *Neutral-Swear,* 617.76ms (SD = 333.46). The dependent variable for this analysis was the log-transformed response times for each button press (*logRT)*. As stated above, the response window started after the offset of the second word and continued for a maximum of 1750ms. Outliers greater than 2.5 standard deviations from each participant's mean response time were rejected using the function *perSubjectTrim.fnc()* (Tremblay & Ransijn, 2012). This measure was taken in order to exclude the possibility that participants reacted before completely hearing a word, as well as extremely late responses that may indicate either distraction or overthinking. 19 trials (1.3% of the data) were excluded in this fashion. Multiple graphs of response time by trial-number for each participant suggested that presentation order (*Trial*) might have had a strong effect on response times (Fig. 4).

[8] "Birth Province" was also included, however due to a large number of different birth provinces (10) relative to the number of participants (30), statistical analysis of this factor proved to be intractable.

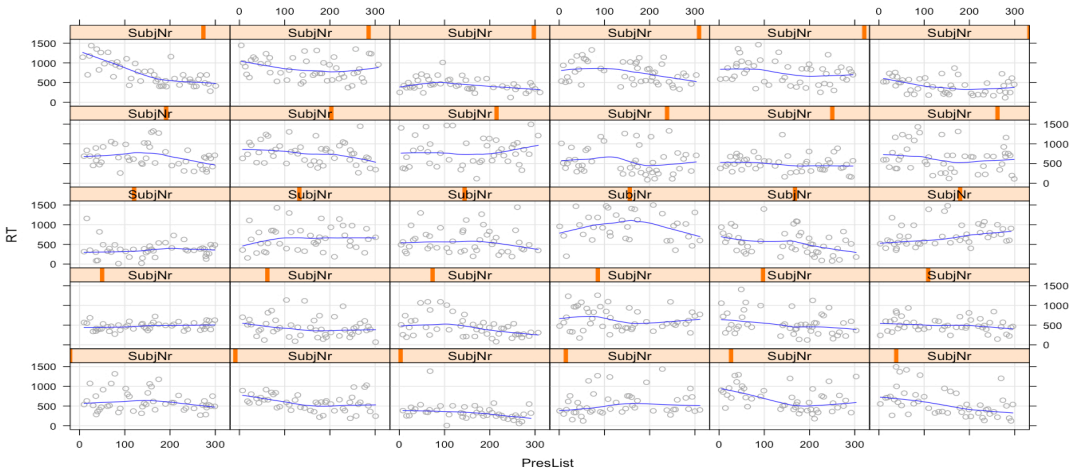

Figure 4. Response time over course of experiment by participant. Each panel represents the reaction times of the 30 participants (ordered left to right, bottom to top) over the course of the experiment. The x-axis indicates trial number, while the y-axis indicates the reaction time for that trial and blue line represents the smoothed data. Generated using *xylowess.fnc()* from the package *languageR* (Baayen, 2012).

Values for this variable were therefore centered (*cTrial*) by subtracting the mean from each value of *Trial* and included in model fitting.

An initial model ("RT.lmer.SubjTrim") was then fitted using consecutive likelihood ratio tests to justify the inclusion of random intercepts for *Subject* and *Item*, as well as the removal of the correlation parameter between *Subject* and *cTrial* (re: Baayen, 2008, Ch. 7). Fixed-effects for the model included *cTrial, Condition*, and *dB-Difference*. Visual inspection of the residuals for this initial model indicated the presence of outliers, particularly in early responses times, which might have skewed predictions (Fig. 5, upper two

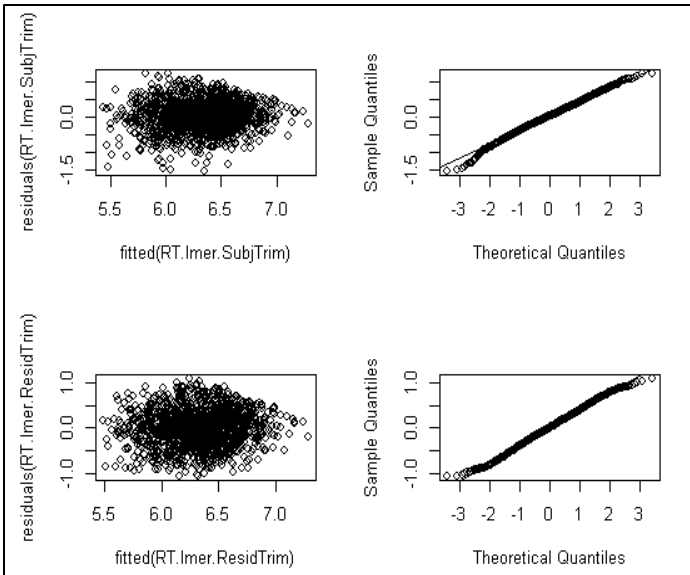

Figure 5. Model Comparison Plots for Response Time Analysis. Upper two panels correspond to a model in which greater than ±2.5 SD were excluded for each participant. Bottom two panels correspond to subsequent model in which residual outliers greater than ±2.5 SD were also excluded. Visual inspection indicates that the second model is a better fit for the data.

panels). Therefore a trimmed model ("RT.lmer.Residtrim") fit by excluding residuals greater than 2.5 standard deviations from the mean using the *romr.fnc()* function

(Tremblay & Ransijn, 2012). This amounted to 20 trials (1.4% of the remaining data). Visual comparison confirms a better fit for this trimmed model (Fig. 5, lower two panels). Estimates and pMCMC values for the final model are summarized in Table 2. All non-significant higher order interactions were removed from the model. A likelihood ratio

Table 2. Summary of Linear Mixed-effects model for Response Time.

Formula: *logRT ~ 1 +cTrial* dB_Difference * CondAB + (1 | SubjNr) + (0+cTrial|SubjNr) + (1 | ItemNr)*

AIC	BIC	logLik	deviance	REMLdv
1756	**1861**	-858.2	1571	1716

Random Effects:

Groups	Name	Variance	Std. Dev.
Subject	cTrial	1.0347e-06	0.0010172
Subject	(intercept)	7.0769e-02	0.2660251
Item	(intercept)	1.1660e-02	0.1079802
Residual		1.6428e-01	0.4053133
	Number of obs: 1379, Groups: *Item (24), Subject (30)*		

Fixed Effects:

	Estimate	Std. Error	MCMC mean	pMCMC	Pr(>|t|)
(Intercept)	6.3681	6.333e-02	6.3693	0.0001	0.0000
cTrial	-0.008	3.362e-04	-0.0009	0.0134	0.0120**
Neutral2-Neutral1	-0.1464	3.353e-02	-0.1460	0.0001	0.0000***
Neutral-Swear	-0.0452	5.790e-02	-0.0445	0.4422	0.4348
Swear-Neutral	0.0076	5.785e-02	0.0081	0.8928	0.8949
dB-Difference	-0.0217	6.796e-02	-0.0218	0.7510	0.7495
cTrial:Neutral2-Neutral1	0.0007	3.779e-04	0.0007	0.0762	0.0839
cTrial:Neutral-Swear	-0.0010	4.215e-04	-0.0010	0.0172	0.0138*
cTrial:Swear-Neutral	-0.0007	3.896e-04	-0.0006	0.0970	0.0888
cTrial:dB-Difference	0.0007	4.774e-04	0.0007	0.1412	0.1410
Neutral2Neutral1:dB-Diff	-0.0040	1.239e-01	-0.0031	0.9714	0.9744
Neutral-Swear:dB-Diff	0.0888	9.722e-02	0.0900	0.3460	0.3610
SwearNeutral:dB-Diff	-0.0335	9.659e-02	-0.0342	0.7172	0.7290
cTrial:Neu2-Neu1:dB-Diff	0.0000	6.383e-04	0.0000	0.9328	0.9620
cTrial:Neu-Swe:dB-Diff	-0.0021	7.176e-04	-0.0022	0.0036	0.0028**
cTrial:Swe-Neu:dB-Diff	-0.0004	6.527e-04	-0.0004	0.5092	0.5290

Estimates refer to log-transformed response times.

test reveals that the model is a significantly better fit for the data than a null model with only random effects (df =15, Chisq. = 66.183, $p < 0.001$).

The following MCMC-estimated significant results are reported for the trimmed model. The intercept of 6.37 for the log-transformed response times is based on the *Neutral1-Neutral2* condition. The analysis revealed a small but significant main effect for *cTrial* (β= -0.0008, $p_{MCMC} < 0.01$), indicating that response times tended to decrease over the course of the experiment. Response times were estimated to be significantly faster only in the *Neutral2-Neutral1* condition (β= -0.15, $p_{MCMC} < 0.001$). A significant interaction was found between *cTrial* and the *Neutral-Swear* condition (β= -0.10, $p_{MCMC} < 0.05$), indicating that in this condition response times tended to decrease over the course of the experiment. Finally, a significant three-way interaction was found between *cTrial, dB-Difference,* and the *Neutral-Swear* condition ((β= -0.002, $p_{MCMC} < 0.05$). This interaction suggests that in this condition, the effect of increased loudness of the second word ("Swear") resulted in a decrease in response time but only over the course of the experiment. Multiple post-hoc tests computed using the *mcposthoc.fnc()* function (Tremblay & Ransijn, 2012) confirm that *Neutral2-Neutral1* differed significantly from all other conditions ($p_{MCMC} < 0.05$), while other conditions did not differ significantly from each other.

6. Discussion

6.1 Response Time Discussion

Participants were found to have responded significantly faster only in the *Neutral2-Neutral1* condition, while other conditions did not differ significantly from each other. Considering that this condition also had the highest mean (0.65) for *Button*, it is plausible

that this decrease in reaction time is the result of participants perceiving the *Neutral1* words to be "obviously" louder. Thus, when these words appear second in a pair, the participants may have needed less time to decide which word was loudest. Participants also demonstrated a preference for selecting *Neutral1* when it appeared first in a pair (mean *Button* = 0.47), however response times were found to be slowest in this condition; this suggests that it was more difficult for participants to decide that *Neutral1* was louder when it was presented first. It is reasonable to assume that comparing the loudness of two auditory stimuli requires holding a representation of the first in working memory (Näätänen & Gaillard, 1983). However, if this representation is not stable but tends to decay over time (Mäntysalo & Näätänen, 1987), this may in essence decrease the loudness of the first stimulus. As participants were required to wait until the second word had finished before responding it may be that to some extent participants' memory for the loudness of the first word had deteriorated, thus making it more difficult to decide which was louder.

Given that in the *Neutral-Swear* condition participants also demonstrated a strong preference for selecting *Swear* (mean *Button* = 0.61), this might also lead us to expect that as in the *Neutral2-Neutral1* condition, response times should be faster compared to *Swear-Neutral*. However, the results reveal that these conditions did not differ significantly from each other. The absence of a decrease in response times may be attributable to a general, task irrelevant slow-down effect due to the emotional load of the *Swear*. Such an effect has been found across a range of tasks such as lexical decision and Emotional Stroop (Algum, Chajut & Lev, 2004). In the absence of electro-dermal response measurements, this is the

clearest indicator that, as expected, participants had a reaction to the emotional load of the swear words.

6.2 Word Selection Discussion

The results of the word selection analysis suggest that for the Test items, listeners tended to perceive swear words as louder than neutral words, in accordance with predictions, and this effect appears to be unrelated to the relative intensity of the *Swear* words compared to the *Neutral* words. Multiple t-tests suggested that participants tended to perceive the *Swear* words as louder. However, it was also found that participants tended to consistently perceive certain Control words as louder than others, namely, words from the *Control1* list. In order to determine whether there was a difference between Test items and Control items for this effect, it was therefore necessary to investigate the role of the relative intensity of words within a pair (*dB-Difference).* The results of the mixed effects analysis suggest that when a participant encountered a Control pair of neutral words A and B (e.g. "geld" and "veld"), the average intensity of word B relative to the average intensity of word A had a significant effect on selection, that is, participants tended to select the word with greater average intensity. However, for Test items in the *Neutral-Swear* and *Swear-Neutral,* this relative intensity did not have a significant effect on word selection, and the slopes for these interactions between *dB-Difference* and *Neutral-Swear* suggest that if there is a correlation, it is that as the intensity of a *Swear* word increases the likelihood of a participant selecting that word in fact decreases.

While these results are promising indicators that listeners do in fact perceive emotionally loaded words as louder than neutral words, these results must be taken with caution; it is entirely reasonable that possible confounding factors call the validity of this

data into question. For example, it is unclear to what extent the loudness judgments made by participants were influenced by phonemic differences between the stimuli; inspection of the by-Item responses (Appendix 2) suggests that these phonemic differences might have had an as-great or even greater effect on loudness comparisons than emotional load. However, because a random effect for *Item* was included, which adjusts the intercept of each word pair (combining AB and BA presentation to factor out the influence of order) according to its deviance from the population average (Baayen, Davidson & Bates, 2008), the statistical model accounts for item specific variation when estimating the effects of the independent variables. This reduces the likelihood that the significant effects for the *Swear-Neutral* and *Neutral-Swear* conditions can be attributed to phonemic rather than emotional factors.

A comparison of a subset of Test and Control items with similar phonemes may provide a rough estimate of the strength of the phonemic differences. For example, items 3, 7, 19, and 22 all consist of minimal pairs distinguished by a /t/ in one word and an /n/ in the other (3 & 7: syllable-initial, 19 & 22: syllable-final; Fig. 6). In items 3 (tering~nering) and 19 (laat~laan), the relative intensity difference is minimal (<0.3dB), yet in both cases there is an overwhelming bias towards the word containing /t/, indicating that the intrinsic intensity or salience of this phoneme is much greater than /n/[9]. However, in items 7 (teef~neef) and 22 (staat~staan), the words containing /n/ are, respectively, 1.19 dB and 1.73 dB louder than the words containing /t/. In item 22, this leads to a slight preference for participants to choose "staan" over "staat." This suggests that "staat" is perceived on

[9] As the RSL of /t/ = 85.3 and /n/ = 86.75, this would lead to the expectation that the /n/ words should be perceived as louder. As this clearly is not the case, this suggests that RSL did not function as an accurate heuristic for comparing phonemes.

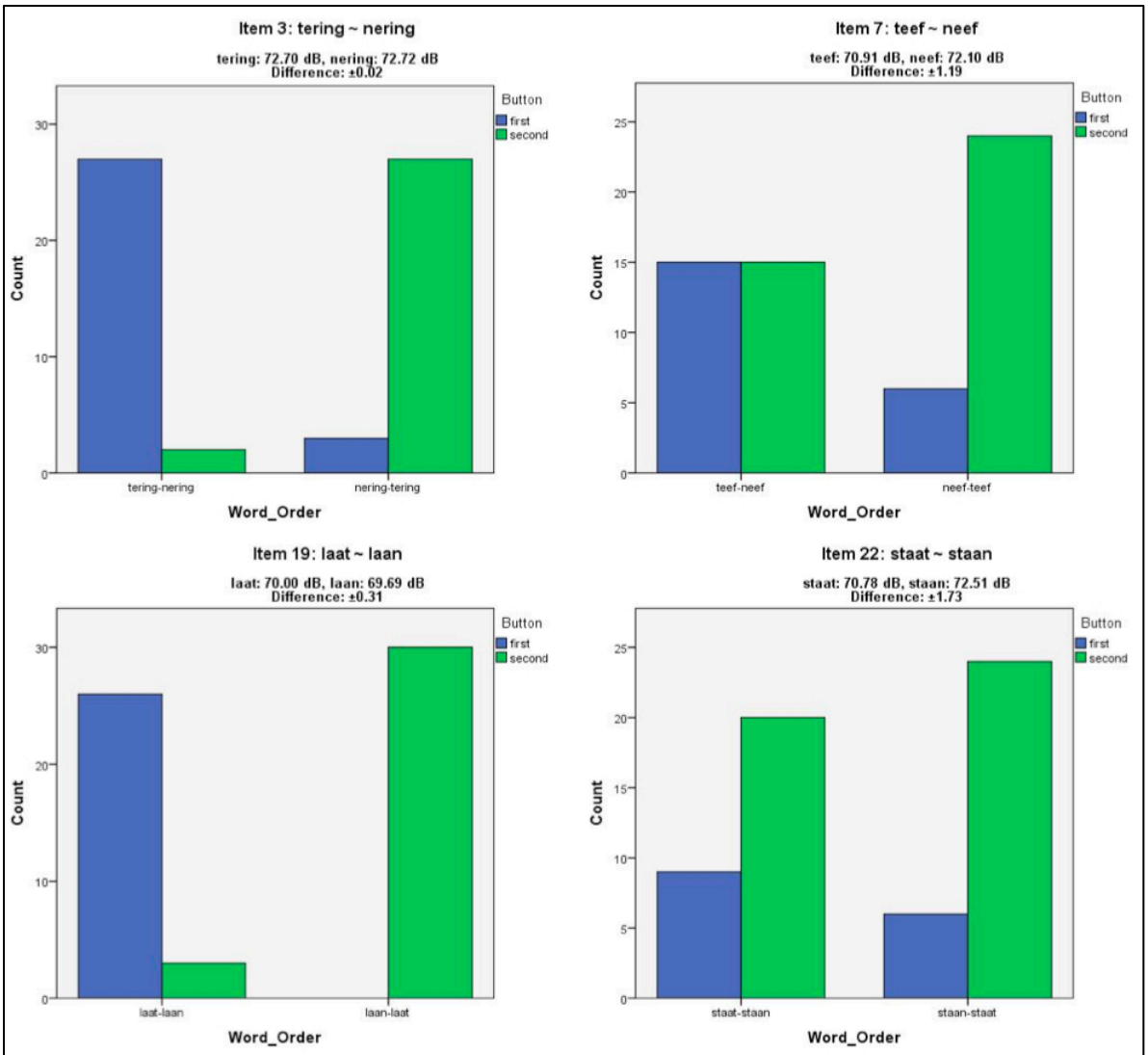

Figure 6. Item Comparison. Results of *Button* are given for items 3, 7, 19, and 22. Results for items 3 and 7 suggest words with /t/ may be perceived as louder than words with /n/ presented at equal intensity. Results for item 22 show that when the average intensity of "staan" is 1.73 dB louder than "staat," the two words appear to be equal in loudness. In Item 7, "neef" is 1.19 dB more intense than "teef," yet responses are biased towards the swear word.

average as approximately 1.7 dB louder than "staan." In item 7 even though "neef" is has a 1.19 dB greater average intensity, there is still a strong preference for "teef." This difference can therefore either be attributed to 1.19 dB not being a large enough difference to overcome the salience of the /t/ phoneme, or it may be attributed to the magnification of loudness due to the emotional load of "teef."

6.3 General Discussion

While it is unlikely that the significant results of the model can be attributed solely to phonemic differences between the stimuli, such a possibility cannot be definitively excluded. Therefore while these results should be taken with a grain of salt, they do provide some of the first promising evidence that emotional reactions to swear words may influence the perception of loudness. Assuming for the moment that this is in fact the case, it raises two important questions: the first, why should perception of loudness increase in response to certain words, and the second, why should this effect target negative or taboo words specifically? The answer to both questions pertains to how attention is captured by salience and by significance; this discussion begins with the latter.

6.3.1 Salience and relevance.

In everyday life, our eyes, ears, and other sensory organs are constantly being bombarded with information. However, with limited neural resources it is impossible to attend to every single sensation (Vuilleumier, 2005). Therefore our attention to sensory information, such as the different sounds in our environment, is biased towards things that are interesting or relevant to the perceiver (Fritz, Elhilala, David & Shamma, 2007). Research into how humans separate the relevant from the non-relevant suggests that this is a swift and automatic process; measurements of brain activity using electroencephalography (EEG) reveal that the brain differentiates a personally significant sound from non-significant sounds, e.g. a person's own ring tone from other ring tones, as early as 40ms after the onset of the sound (Roye, Schröger, Jacobsen, & Gruber, 2010).

With regard to personal relevance, it is likely that the detection of possible threats to one's personal well-being rank highly. As Zadra & Clore (2010) express so aptly, "…*even*

the most avid chess player is likely to stop his game upon noticing that his house is on fire" (pp. 2). Therefore the evolutionary impetus for a bias towards negative stimuli is fairly self-evident; if a person is better able to detect a threat to her life, such as a large predatory cat lurking in the environment or the angry face of an assailant in a crowd of people, this may increase her chances of survival (Phelps & LeDoux, 2005; Vuilleumier and Huang, 2009). Given the pervasiveness of language, it is not surprising that words with negative emotional or social connotations, such as swear words, are also capable of modulating attention (Strange et al., 2000; Anderson & Phelps, 2001).

It is not necessarily the case that perception is exclusively biased towards negative stimuli; it may be very important for rewarding objects, such as money or food, to capture our attention (Bruner & Goodman 1947; van Koningsbruggen, Stroebe & Aarts, 2011). For example, it beneficial to the perceiver to notice a $100 lying on the ground; however, if in reaching for that money the perceiver fails to notice an oncoming bus, the net outcome of the situation is decidedly negative. Therefore it is clear that given limited cognitive resources, the brain may be biased towards prioritizing attention to negative stimuli.

6.3.2 Salience and attentional capture.

The next issue to consider is that once a significant object, such as a rabid tiger, is detected by our sensory organs, how are neural resources redirected to this stimulus? Attention can be directed by voluntary cognitive processes, e.g. when we are looking for a stapler on a messy desk or attempting to listen to a specific voice in a crowded party. On the other hand, attention can be "captured" by bottom-up, salient sensory events, such as when we can't help but focus on a single blue flower in a field of yellow flowers (Itti & Koch,

2001), or a loud ambulance siren (Watkins, Dali, Lavie & Rees, 2006). The question then becomes how to define and quantify salient properties of sensory events.

In the visual domain, computational models have been developed to assess how objects in a visual scene may "pop out" and capture attention (Koch & Ullman, 1985). Such models, called "saliency maps," attempt to quantify the salience of various features, e.g. color, orientation and velocity of motion for vision (Itti & Koch, 2001), and frequency, temporal contrast, and intensity for audition (Kayser, Petkov, Lippert & Logothetis, 2005). These models attempt to predict which objects in a given context will capture attention; as these predictions have been found to correlate well with human behavior, this suggests that our attention is also sensitive to parameters such as these, e.g. a sudden change in intensity as when a gun is fired.

6.3.3. Loudness and auditory salience.

While increases in intensity have been demonstrated to elicit attention-capturing effects, it is important to remember that intensity is a physical characteristic of sound waves. However, as discussed in Section 4.1, loudness is a psychological construct that does not necessarily correlate with acoustic intensity (Fletcher & Munson, 1933; Moore, 2008). For example, short sounds maintained at a steady intensity are perceived as increasing in loudness even though no intensity change is occurring (Reinhard-Rutland, 2004), and speech sounds that are perceived to be equally loud may differ in intensity (Lehiste & Peterson, 1959; Ladefoged & McKinney, 1963). Given such subjective differences, it is plausible that top-down processes are capable of influencing the perception of loudness.

Increases in loudness seem to correlate with increases in activity in the auditory cortex (Langers, Dijk, Schoonmaker & Backes, 2006; Röhl & Uppenkamp, 2012), Research

utilizing functional near-infrared spectroscopy (fNIRS) has found increased activity in the AC in response to positive (e.g. laughter) and negative (e.g. infant cries) auditory stimuli as compared to neutral stimuli (e.g. a clock ticking; Plichta et al., 2011). As the auditory cortex receives input from the amygdala and other regions of the brain (Sah et al., 2003), it may be the case that activity in these areas leads to increased activation in the AC, thereby increasing the sensation of loudness by means of a top-down mechanism. As a result, the relative salience of the auditory stimulus may be magnified, thus making it more likely for that specific item to "pop out" and capture our attention. In this way, a particularly significant auditory stimulus, such as a socially inappropriate swear word, may capture our attention by seeming louder.

However, this explanation implies that it was the increase in loudness that led to a shift in attention; it is also possible that increased activity in the auditory cortex is actually a result of shifting attention. In this case, an increase in perceived loudness would simply be a by-product, and not a cause, of this process. Further research is needed in order to determine which may be the case.

7. Conclusion

In light of the wealth of evidence demonstrating how emotion in language can enhance or modulate perception, as well as recent evidence suggesting that emotional responses to certain sounds can affect the perception of loudness (Asutay & Västjäll, 2012), it is very likely that such effects also occur in response to emotional content in language. The purpose of this study was to determine whether emotional reactions to certain words might influence how loud those words are perceived to be. Results of the experiment

suggest that listeners perceive swear words to be louder than comparable neutral words, and in contrast to the neutral control stimuli, this effect cannot be attributed to acoustic factors. In discussing these results, I have proposed that such loudness magnification may facilitate attentional capture, i.e. "pop out," for socially relevant linguistic stimuli.

While it is regrettable that the possible confounding effect of phonemic differences between the stimuli could not be clearly ruled out, this study provides a solid foundation for future research into this phenomenon. Hopefully this study will be a first step towards investigating how emotional reactions to language may affect the perception of loudness, thereby contributing to a greater understanding of the interactions between emotion, perception and language.

8. References

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Appendices

Appendix 1A: Experimental Stimuli

ItemNr	Condition	wordA	FileA_dB	wordB	FileB_dB	dB_Difference
1	SwearNeutral	kanker	70.36964	kanjer	71.53231	1.16267
1	NeutralSwear	kanjer	71.53231	kanker	70.36964	-1.16267
2	SwearNeutral	flikker	68.80695	kikker	68.83717	0.03022
2	NeutralSwear	kikker	68.83717	flikker	68.80695	-0.03022
3	SwearNeutral	tering	72.69874	nering	72.71799	0.01925
3	NeutralSwear	nering	72.71799	tering	72.69874	-0.01925
4	SwearNeutral	eikel	72.06763	eiken	71.32968	-0.73795
4	NeutralSwear	eiken	71.32968	eikel	72.06763	0.73795
5	SwearNeutral	hoer	70.90844	boer	70.89942	-0.00902
5	NeutralSwear	boer	70.89942	hoer	70.90844	0.00902
6	SwearNeutral	lul	72.99353	nul	72.9904	-0.00313
6	NeutralSwear	nul	72.9904	lul	72.99353	0.00313
7	SwearNeutral	teef	70.90827	neef	72.09635	1.18808
7	NeutralSwear	neef	72.09635	teef	70.90827	-1.18808
8	SwearNeutral	klote	72.08926	blote	72.08603	-0.00323
8	NeutralSwear	blote	72.08603	klote	72.08926	0.00323
9	SwearNeutral	kut	68.85417	dut	69.75695	0.90278
9	NeutralSwear	dut	69.75695	kut	68.85417	-0.90278
10	SwearNeutral	wijf	70.25526	wijs	70.6881	0.43284
10	NeutralSwear	wijs	70.6881	wijf	70.25526	-0.43284
11	SwearNeutral	gelul	69.56281	geluk	70.20891	0.6461
11	NeutralSwear	geluk	70.20891	gelul	69.56281	-0.6461
12	SwearNeutral	slet	70.67567	smet	70.67743	0.00176
12	NeutralSwear	smet	70.67743	slet	70.67567	-0.00176
13	SwearNeutral	klere	71.18502	klare	71.18503	1.00E-05
13	NeutralSwear	klare	71.18503	klere	71.18502	-1.00E-05

14	Neutral1Neutral2	daar	70.67025	haar	70.75718	0.08693
14	Neutral2Neutral1	haar	70.75718	daar	70.67025	-0.08693
15	Neutral1Neutral2	dag	67.57492	das	67.78017	0.20525
15	Neutral2Neutral1	das	67.78017	dag	67.57492	-0.20525
16	Neutral1Neutral2	dit	67.55526	dik	67.77882	0.22356
16	Neutral2Neutral1	dik	67.77882	dit	67.55526	-0.22356
17	Neutral1Neutral2	geld	70.01993	veld	69.18666	-0.83327
17	Neutral2Neutral1	veld	69.18666	geld	70.01993	0.83327
18	Neutral1Neutral2	heel	71.86565	deel	71.97448	0.10883
18	Neutral2Neutral1	deel	71.97448	heel	71.86565	-0.10883
19	Neutral1Neutral2	laat	69.99954	laan	69.68633	-0.31321
19	Neutral2Neutral1	laan	69.68633	laat	69.99954	0.31321
20	Neutral1Neutral2	maar	71.69219	jaar	71.65698	-0.03521
20	Neutral2Neutral1	jaar	71.65698	maar	71.69219	0.03521
21	Neutral1Neutral2	morgen	71.59388	morsen	71.60096	0.00708
21	Neutral2Neutral1	morsen	71.60096	morgen	71.59388	-0.00708
22	Neutral1Neutral2	staat	70.78046	staan	72.5089	1.72844
22	Neutral2Neutral1	staan	72.5089	staat	70.78046	-1.72844
23	Neutral1Neutral2	tussen	72.22439	mussen	72.34172	0.11733
23	Neutral2Neutral1	mussen	72.34172	tussen	72.22439	-0.11733
25	Neutral1Neutral2	zeker	71.78715	beker	71.55936	-0.22779
25	Neutral2Neutral1	beker	71.55936	zeker	71.78715	0.22779

Appendix 1B: Fillers.

Word_List_Version (v0 = “Loud,” v1 = “Soft”)

Test Item Fillers						
StimNr	Loudness	fileA	FileA_dB	fileB	FileB_dB	dB-

	Combination					Difference
53	LoudSoft,	kanker_TSwe_v0.wav,	70.37	kanjer_TNeu_v1.wav;	69.04	-1.33
54	SoftLoud,	kanjer_TNeu_v1.wav,	69.04	kanker_TSwe_v0.wav;	70.37	1.33
55	SoftLoud,	flikker_TSwe_v1.wav,	66.81	kikker_TNeu_v0.wav;	68.84	2.03
56	LoudSoft,	kikker_TNeu_v0.wav,	68.84	flikker_TSwe_v1.wav;	66.81	-2.03
57	SoftLoud,	tering_TSwe_v1.wav,	70.26	nering_TNeu_v0.wav;	72.72	2.46
58	LoudSoft,	nering_TNeu_v0.wav,	72.72	tering_TSwe_v1.wav;	70.26	-2.46
59	SoftLoud,	eikel_TSwe_v1.wav,	70.07	eiken_TNeu_v0.wav;	71.33	1.26
60	LoudSoft,	eiken_TNeu_v0.wav,	71.33	eikel_TSwe_v1.wav;	70.07	-1.26
61	SoftLoud,	hoer_TSwe_v1.wav,	68.91	boer_TNeu_v0.wav;	70.90	1.99
62	LoudSoft,	boer_TNeu_v0.wav,	70.90	hoer_TSwe_v1.wav;	68.91	-1.99
63	SoftLoud,	lul_TSwe_v1.wav,	70.99	null_TNeu_v0.wav;	72.99	2.00
64	LoudSoft,	null_TNeu_v0.wav,	72.99	lul_TSwe_v1.wav;	70.99	-2.00
65	SoftLoud,	teef_TSwe_v1.wav,	66.75	neef_TNeu_v0.wav;	72.10	5.35
66	LoudSoft,	neef_TNeu_v0.wav,	72.10	teef_TSwe_v1.wav;	66.75	-5.35
67	SoftLoud,	klote_TSwe_v1.wav,	70.09	blote_TNeu_v0.wav;	72.09	2.00
68	LoudSoft,	blote_TNeu_v0.wav,	72.09	klote_TSwe_v1.wav;	70.09	-2.00
69	SoftLoud,	kut_TSwe_v1.wav,	65.85	dut_TNeu_v0.wav;	69.76	3.90
70	LoudSoft,	dut_TNeu_v0.wav,	69.76	kut_TSwe_v1.wav;	65.85	-3.90
71	LoudSoft,	wijf_TSwe_v0.wav,	70.26	wijs_TNeu_v1.wav;	68.64	-1.62
72	SoftLoud,	wijs_TNeu_v1.wav,	68.64	wijf_TSwe_v0.wav;	70.26	1.62
73	SoftLoud,	gelul_TSwe_v1.wav,	69.56	geluk_TNeu_v0.wav;	70.21	0.65
74	LoudSoft,	geluk_TNeu_v0.wav,	70.21	gelul_TSwe_v1.wav;	69.56	-0.65
75	SoftLoud,	slet_TSwe_v1.wav,	68.28	smet_TNeu_v0.wav;	70.68	2.40
76	LoudSoft,	smet_TNeu_v0.wav,	70.68	slet_TSwe_v1.wav;	68.28	-2.40
77	SoftLoud,	klere_TSwe_v1.wav,	68.52	klare_TNeu_v0.wav;	71.19	2.67
78	LoudSoft,	klare_TNeu_v0.wav,	71.19	klere_TSwe_v1.wav;	68.52	-2.67
Control Item Fillers						

StimNr	Loudness Combination	fileA	FileA_dB	fileB	FileB_dB	dB-Difference
79	LoudSoft,	daar_C1Neu_v0.wav,	70.67	haar_C2Neu_v1.wav;	68.30	-2.37
80	SoftLoud,	haar_C2Neu_v1.wav,	68.30	daar_C1Neu_v0.wav;	70.67	2.37
81	LoudSoft,	dag_C1Neu_v0.wav,	67.57	das_C2Neu_v1.wav;	64.99	-2.59
82	SoftLoud,	das_C2Neu_v1.wav,	64.99	dag_C1Neu_v0.wav;	67.57	2.59
83	LoudSoft,	dit_C1Neu_v0.wav,	67.56	dik_C2Neu_v1.wav;	65.78	-1.78
84	SoftLoud,	dik_C2Neu_v1.wav,	65.78	dit_C1Neu_v0.wav;	67.56	1.78
85	LoudSoft,	geld_C1Neu_v0.wav,	70.02	veld_C2Neu_v1.wav;	65.49	-4.53
86	SoftLoud,	veld_C2Neu_v1.wav,	65.49	geld_C1Neu_v0.wav;	70.02	4.53
87	LoudSoft,	heel_C1Neu_v0.wav,	71.87	deel_C2Neu_v1.wav;	69.97	-1.89
88	SoftLoud,	deel_C2Neu_v1.wav,	69.97	heel_C1Neu_v0.wav;	71.87	1.89
89	LoudSoft,	laat_C1Neu_v0.wav,	70.00	laan_C2Neu_v1.wav;	69.69	-0.31
90	SoftLoud,	laan_C2Neu_v1.wav,	69.69	laat_C1Neu_v0.wav;	70.00	0.31
91	LoudSoft,	maar_C1Neu_v0.wav,	71.69	jaar_C2Neu_v1.wav;	69.66	-2.04
92	SoftLoud,	jaar_C2Neu_v1.wav,	69.66	maar_C1Neu_v0.wav;	71.69	2.04
93	SoftLoud,	morgen_C1Neu_v1.wav,	68.59	morsen_C2Neu_v0.wav;	71.60	3.01
94	LoudSoft,	morsen_C2Neu_v0.wav,	71.60	morgen_C1Neu_v1.wav;	68.59	-3.01
95	SoftLoud,	staat_C1Neu_v1.wav,	66.77	staan_C2Neu_v0.wav;	72.51	5.74
96	LoudSoft,	staan_C2Neu_v0.wav,	72.51	staat_C1Neu_v1.wav;	66.77	-5.74
97	LoudSoft,	tussen_C1Neu_v0.wav,	72.22	mussen_C2Neu_v1.wav;	70.28	-1.95
98	SoftLoud,	mussen_C2Neu_v1.wav,	70.28	tussen_C1Neu_v0.wav;	72.22	1.95
99	LoudSoft,	weg_C1Neu_v0.wav,	69.41	web_C2Neu_v1.wav;	63.58	-5.83
100	SoftLoud,	web_C2Neu_v1.wav,	63.58	weg_C1Neu_v0.wav;	69.41	5.83
101	LoudSoft,	zeker_C1Neu_v0.wav,	71.79	beker_C2Neu_v1.wav;	68.97	-2.81
102	SoftLoud,	beker_C2Neu_v1.wav,	68.97	zeker_C1Neu_v0.wav;	71.79	2.81
103	SoftLoud,	zit_C1Neu_v1.wav,	66.13	zin_C2Neu_v0.wav;	70.73	4.60
104	LoudSoft,	zin_C2Neu_v0.wav,	70.73	zit_C1Neu_v1.wav;	66.13	-4.60

Confound Fillers						
StimNr	Loudness Combination	fileA	FileA_dB	fileB	FileB_dB	dB-Difference
105	LoudSoft,	hoi_F1_v0.wav,	71.55	hou_F2_v1.wav;	68.65	-2.90
106	SoftLoud,	hou_F2_v1.wav,	68.65	hoi_F1_v0.wav;	71.55	2.90
107	SoftLoud,	hoi_F1_v1.wav,	69.55	hou_F2_v0.wav;	71.31	1.76
108	LoudSoft,	hou_F2_v0.wav,	71.31	hoi_F1_v1.wav;	69.55	-1.76
109	LoudSoft,	doei_F1_v0.wav,	74.88	boei_F2_v1.wav;	72.73	-2.15
110	SoftLoud,	boei_F2_v1.wav,	72.73	doei_F1_v0.wav;	74.88	2.15
111	SoftLoud,	doei_F1_v1.wav,	72.88	boei_F2_v0.wav;	74.98	2.10
112	LoudSoft,	boei_F2_v0.wav,	74.98	doei_F1_v1.wav;	72.88	-2.10
113	LoudSoft,	groetjes_F1_v0.wav,	67.59	groepjes_F2_v1.wav;	65.54	-2.05
114	SoftLoud,	groepjes_F2_v1.wav,	65.54	groetjes_F1_v0.wav;	67.59	2.05
115	SoftLoud,	groetjes_F1_v1.wav,	64.22	groepjes_F2_v0.wav;	67.53	3.31
116	LoudSoft,	groepjes_F2_v0.wav,	67.53	groetjes_F1_v1.wav;	64.22	-3.31
117	LoudSoft,	ach_F1_v0.wav,	68.03	och_F2_v1.wav;	65.93	-2.10
118	SoftLoud,	och_F2_v1.wav,	65.93	ach_F1_v0.wav;	68.03	2.10
119	SoftLoud,	ach_F1_v1.wav,	66.03	och_F2_v0.wav;	68.03	2.00
120	LoudSoft,	och_F2_v0.wav,	68.03	ach_F1_v1.wav;	66.03	-2.00
121	LoudSoft,	tja_F1_v0.wav,	70.71	mja_F2_v1.wav;	67.80	-2.91
122	SoftLoud,	mja_F2_v1.wav,	67.80	tja_F1_v0.wav;	70.71	2.91
123	SoftLoud,	tja_F1_v1.wav,	68.71	mja_F2_v0.wav;	70.59	1.88
124	LoudSoft,	mja_F2_v0.wav,	70.59	tja_F1_v1.wav;	68.71	-1.88
125	LoudSoft,	ik_F1_v0.wav,	67.57	ook_F2_v1.wav;	56.66	-10.91
126	SoftLoud,	ook_F2_v1.wav,	56.66	ik_F1_v0.wav;	67.57	10.91
127	SoftLoud,	ik_F1_v1.wav,	65.57	ook_F2_v0.wav;	65.75	0.18
128	LoudSoft,	ook_F2_v0.wav,	65.75	ik_F1_v1.wav;	65.57	-0.18
129	LoudSoft,	jij_F1_v0.wav,	71.17	zij_F2_v1.wav;	68.31	-2.86
130	SoftLoud,	zij_F2_v1.wav,	68.31	jij_F1_v0.wav;	71.17	2.86

131	SoftLoud,	jij_F1_v1.wav,	69.17	zij_F2_v0.wav;	71.06	1.89
132	LoudSoft,	zij_F2_v0.wav,	71.06	jij_F1_v1.wav;	69.17	-1.89
133	LoudSoft,	Wilders_F1_v0.wav,	69.72	vilders_F2_v1.wav;	66.83	-2.89
134	SoftLoud,	vilders_F2_v1.wav,	66.83	Wilders_F1_v0.wav;	69.72	2.89
135	SoftLoud,	Wilders_F1_v1.wav,	67.72	vilders_F2_v0.wav;	69.62	1.90
136	LoudSoft,	vilders_F2_v0.wav,	69.62	Wilders_F1_v1.wav;	67.72	-1.90
137	LoudSoft,	rutte_F1_v0.wav,	69.33	putte_F2_v1.wav;	65.67	-3.66
138	SoftLoud,	putte_F2_v1.wav,	65.67	rutte_F1_v0.wav;	69.33	3.66
139	SoftLoud,	rutte_F1_v1.wav,	67.33	putte_F2_v0.wav;	69.32	1.99
140	LoudSoft,	putte_F2_v0.wav,	69.32	rutte_F1_v1.wav;	67.33	-1.99
141	LoudSoft,	Cohen_F1_v0.wav,	74.64	koken_F2_v1.wav;	72.03	-2.61
142	SoftLoud,	koken_F2_v1.wav,	72.03	Cohen_F1_v0.wav;	74.64	2.61
143	SoftLoud,	Cohen_F1_v1.wav,	72.20	koken_F2_v0.wav;	74.03	1.83
144	LoudSoft,	koken_F2_v0.wav,	74.03	Cohen_F1_v1.wav;	72.20	-1.83
145	LoudSoft,	Osama_F1_v0.wav,	72.66	Obama_F2_v1.wav;	70.13	-2.53
146	SoftLoud,	Obama_F2_v1.wav,	70.13	Osama_F1_v0.wav;	72.66	2.53
147	SoftLoud,	Osama_F1_v1.wav,	70.66	Obama_F2_v0.wav;	72.79	2.13
148	LoudSoft,	Obama_F2_v0.wav,	72.79	Osama_F1_v1.wav;	70.66	-2.13
149	LoudSoft,	haat_F1_v0.wav,	70.27	haan_F2_v1.wav;	69.81	-0.46
150	SoftLoud,	haan_F2_v1.wav,	69.81	haat_F1_v0.wav;	70.27	0.46
151	SoftLoud,	haat_F1_v1.wav,	66.27	haan_F2_v0.wav;	71.81	5.53
152	LoudSoft,	haan_F2_v0.wav,	71.81	haat_F1_v1.wav;	66.27	-5.53
153	LoudSoft,	steken_F1_v0.wav,	70.37	smeken_F2_v1.wav;	70.91	0.54
154	SoftLoud,	smeken_F2_v1.wav,	70.91	steken_F1_v0.wav;	70.37	-0.54
155	SoftLoud,	steken_F1_v1.wav,	64.75	smeken_F2_v0.wav;	72.91	8.16
156	LoudSoft,	smeken_F2_v0.wav,	72.91	steken_F1_v1.wav;	64.75	-8.16
Random Match Fillers						
StimNr	Loudness	fileA	FileA_dB	fileB	FileB_dB	dB-

	Combination					Difference
157	SoftLoud,	groepjes_F2_v1.wav,	65.54	putte_F2_v0.wav;	69.32	3.78
158	LoudSoft,	putte_F2_v0.wav,	69.32	groepjes_F2_v1.wav;	65.54	-3.78
159	SoftLoud,	mussen_C2Neu_v1.wav,	70.28	och_F2_v0.wav;	68.03	-2.25
160	LoudSoft,	och_F2_v0.wav,	68.03	mussen_C2Neu_v1.wav;	70.28	2.25
161	SoftLoud,	wijs_TNeu_v1.wav,	68.64	eiken_TNeu_v0.wav;	71.33	2.69
162	LoudSoft,	eiken_TNeu_v0.wav,	71.33	wijs_TNeu_v1.wav;	68.64	-2.69
163	LoudSoft,	eikel_TSwe_v0.wav,	72.07	tering_TSwe_v1.wav;	70.26	-1.80
164	SoftLoud,	tering_TSwe_v1.wav,	70.26	eikel_TSwe_v0.wav;	72.07	1.80
165	SoftLoud,	kanjer_TNeu_v1.wav,	69.04	Obama_F2_v0.wav;	72.79	3.75
166	LoudSoft,	Obama_F2_v0.wav,	72.79	kanjer_TNeu_v1.wav;	69.04	-3.75
167	LoudSoft,	web_C2Neu_v0.wav,	67.22	Osama_F1_v1.wav;	70.66	3.44
168	SoftLoud,	Osama_F1_v1.wav,	70.66	web_C2Neu_v0.wav;	67.22	-3.44
169	SoftLoud,	ook_F2_v1.wav,	56.66	heel_C1Neu_v0.wav;	71.87	15.20
170	LoudSoft,	heel_C1Neu_v0.wav,	71.87	ook_F2_v1.wav;	56.66	-15.20
171	SoftLoud,	zeker_C1Neu_v1.wav,	69.79	dut_TNeu_v0.wav;	69.76	-0.03
172	LoudSoft,	dut_TNeu_v0.wav,	69.76	zeker_C1Neu_v1.wav;	69.79	0.03
173	LoudSoft,	beker_C2Neu_v0.wav,	71.56	blote_TNeu_v1.wav;	70.08	-1.48
174	SoftLoud,	blote_TNeu_v1.wav,	70.08	beker_C2Neu_v0.wav;	71.56	1.48
175	SoftLoud,	klare_TNeu_v1.wav,	69.19	neef_TNeu_v0.wav;	72.10	2.91
176	LoudSoft,	neef_TNeu_v0.wav,	72.10	klare_TNeu_v1.wav;	69.19	-2.91
177	LoudSoft,	groetjes_F1_v0.wav,	67.59	vilders_F2_v1.wav;	66.83	-0.75
178	SoftLoud,	vilders_F2_v1.wav,	66.83	groetjes_F1_v0.wav;	67.59	0.75
179	SoftLoud,	kut_TSwe_v1.wav,	65.85	laan_C2Neu_v0.wav;	71.69	5.83
180	LoudSoft,	laan_C2Neu_v0.wav,	71.69	kut_TSwe_v1.wav;	65.85	-5.83
181	SoftLoud,	mja_F2_v1.wav,	67.80	zij_F2_v0.wav;	71.06	3.26
182	LoudSoft,	zij_F2_v0.wav,	71.06	mja_F2_v1.wav;	67.80	-3.26
183	SoftLoud,	boei_F2_v1.wav,	72.73	boer_TNeu_v0.wav;	70.90	-1.83
184	LoudSoft,	boer_TNeu_v0.wav,	70.90	boei_F2_v1.wav;	72.73	1.83

185	SoftLoud,	lul_TSwe_v1.wav,	70.99	haan_F2_v0.wav;	71.81	0.81
186	LoudSoft,	haan_F2_v0.wav,	71.81	lul_TSwe_v1.wav;	70.99	-0.81
187	LoudSoft,	laat_C1Neu_v0.wav,	70.00	maar_C1Neu_v1.wav;	69.64	-0.36
188	SoftLoud,	maar_C1Neu_v1.wav,	69.64	laat_C1Neu_v0.wav;	70.00	0.36
189	LoudSoft,	morgen_C1Neu_v0.wav,	71.59	gelul_TSwe_v1.wav;	69.56	-2.03
190	SoftLoud,	gelul_TSwe_v1.wav,	69.56	morgen_C1Neu_v0.wav;	71.59	2.03
191	LoudSoft,	veld_C2Neu_v0.wav,	69.19	Wilders_F1_v1.wav;	67.72	-1.47
192	SoftLoud,	Wilders_F1_v1.wav,	67.72	veld_C2Neu_v0.wav;	69.19	1.47
193	SoftLoud,	kanker_TSwe_v1.wav,	68.37	klere_TSwe_v0.wav;	71.19	2.82
194	LoudSoft,	klere_TSwe_v0.wav,	71.19	kanker_TSwe_v1.wav;	68.37	-2.82
195	LoudSoft,	dag_C1Neu_v0.wav,	67.57	tja_F1_v1.wav;	68.71	1.14
196	SoftLoud,	tja_F1_v1.wav,	68.71	dag_C1Neu_v0.wav;	67.57	-1.14
197	LoudSoft,	teef_TSwe_v0.wav,	70.91	geld_C1Neu_v1.wav;	68.02	-2.89
198	SoftLoud,	geld_C1Neu_v1.wav,	68.02	teef_TSwe_v0.wav;	70.91	2.89
199	LoudSoft,	ach_F1_v0.wav,	68.03	smet_TNeu_v1.wav;	68.68	0.65
200	SoftLoud,	smet_TNeu_v1.wav,	68.68	ach_F1_v0.wav;	68.03	-0.65
201	LoudSoft,	staat_C1Neu_v0.wav,	70.78	hoer_TSwe_v1.wav;	68.91	-1.87
202	SoftLoud,	hoer_TSwe_v1.wav,	68.91	staat_C1Neu_v0.wav;	70.78	1.87
203	LoudSoft,	Cohen_F1_v0.wav,	74.64	weg_C1Neu_v1.wav;	67.41	-7.23
204	SoftLoud,	weg_C1Neu_v1.wav,	67.41	Cohen_F1_v0.wav;	74.64	7.23
205	LoudSoft,	dit_C1Neu_v0.wav,	67.56	haat_F1_v1.wav;	66.27	-1.28
206	SoftLoud,	haat_F1_v1.wav,	66.27	dit_C1Neu_v0.wav;	67.56	1.28
207	SoftLoud,	flikker_TSwe_v1.wav,	66.81	ik_F1_v0.wav;	67.57	0.77
208	LoudSoft,	ik_F1_v0.wav,	67.57	flikker_TSwe_v1.wav;	66.81	-0.77
209	SoftLoud,	deel_C2Neu_v1.wav,	69.97	haar_C2Neu_v0.wav;	70.76	0.78
210	LoudSoft,	haar_C2Neu_v0.wav,	70.76	deel_C2Neu_v1.wav;	69.97	-0.78
211	LoudSoft,	geluk_TNeu_v0.wav,	70.21	doei_F1_v1.wav;	72.88	2.67
212	SoftLoud,	doei_F1_v1.wav,	72.88	geluk_TNeu_v0.wav;	70.21	-2.67
213	LoudSoft,	daar_C1Neu_v0.wav,	70.67	koken_F2_v1.wav;	72.03	1.36

214	SoftLoud,	koken_F2_v1.wav,	72.03	daar_C1Neu_v0.wav;	70.67	-1.36
215	SoftLoud,	morsen_C2Neu_v1.wav,	69.60	steken_F1_v0.wav;	70.37	0.77
216	LoudSoft,	steken_F1_v0.wav,	70.37	morsen_C2Neu_v1.wav;	69.60	-0.77
217	LoudSoft,	staan_C2Neu_v0.wav,	72.51	wijf_TSwe_v1.wav;	68.26	-4.25
218	SoftLoud,	wijf_TSwe_v1.wav,	68.26	staan_C2Neu_v0.wav;	72.51	4.25
219	LoudSoft,	zit_C1Neu_v0.wav,	68.13	jaar_C2Neu_v1.wav;	69.66	1.52
220	SoftLoud,	jaar_C2Neu_v1.wav,	69.66	zit_C1Neu_v0.wav;	68.13	-1.52
221	LoudSoft,	hoi_F1_v0.wav,	71.55	kikker_TNeu_v1.wav;	66.03	-5.52
222	SoftLoud,	kikker_TNeu_v1.wav,	66.03	hoi_F1_v0.wav;	71.55	5.52
223	LoudSoft,	dik_C2Neu_v0.wav,	67.78	nering_TNeu_v1.wav;	70.72	2.94
224	SoftLoud,	nering_TNeu_v1.wav,	70.72	dik_C2Neu_v0.wav;	67.78	-2.94
225	LoudSoft,	das_C2Neu_v0.wav,	67.78	slet_TSwe_v1.wav;	68.28	0.50
226	SoftLoud,	slet_TSwe_v1.wav,	68.28	das_C2Neu_v0.wav;	67.78	-0.50
227	SoftLoud,	smeken_F2_v1.wav,	70.91	tussen_C1Neu_v0.wav;	72.22	1.31
228	LoudSoft,	tussen_C1Neu_v0.wav,	72.22	smeken_F2_v1.wav;	70.91	-1.31
229	SoftLoud,	nul_TNeu_v1.wav,	69.71	jij_F1_v0.wav;	71.17	1.46
230	LoudSoft,	jij_F1_v0.wav,	71.17	nul_TNeu_v1.wav;	69.71	-1.46
231	SoftLoud,	zin_C2Neu_v1.wav,	67.46	klote_TSwe_v0.wav;	72.09	4.62
232	LoudSoft,	klote_TSwe_v0.wav,	72.09	zin_C2Neu_v1.wav;	67.46	-4.62
233	SoftLoud,	hou_F2_v1.wav,	68.65	Rutte_F1_v0.wav;	69.33	0.68
234	LoudSoft,	Rutte_F1_v0.wav,	69.33	hou_F2_v1.wav;	68.65	-0.68
235	SoftLoud,	boei_F2_v1.wav,	72.73	daar_C1Neu_v0.wav;	70.67	-2.06
236	LoudSoft,	daar_C1Neu_v0.wav,	70.67	boei_F2_v1.wav;	72.73	2.06
237	SoftLoud,	beker_C2Neu_v1.wav,	68.97	putte_F2_v0.wav;	69.32	0.34
238	LoudSoft,	putte_F2_v0.wav,	69.32	beker_C2Neu_v1.wav;	68.97	-0.34
239	SoftLoud,	boer_TNeu_v1.wav,	68.46	zij_F2_v0.wav;	71.06	2.59
240	LoudSoft,	zij_F2_v0.wav,	71.06	boer_TNeu_v1.wav;	68.46	-2.59
241	LoudSoft,	ach_F1_v0.wav,	68.03	eiken_TNeu_v1.wav;	67.96	-0.07
242	SoftLoud,	eiken_TNeu_v1.wav,	67.96	ach_F1_v0.wav;	68.03	0.07

243	SoftLoud,	Rutte_F1_v1.wav,	67.33	tussen_C1Neu_v0.wav;	72.22	4.89
244	LoudSoft,	tussen_C1Neu_v0.wav,	72.22	Rutte_F1_v1.wav;	67.33	-4.89
245	LoudSoft,	kanjer_TNeu_v0.wav,	71.53	mja_F2_v1.wav;	67.80	-3.73
246	SoftLoud,	mja_F2_v1.wav,	67.80	kanjer_TNeu_v0.wav;	71.53	3.73
247	SoftLoud,	haan_F2_v1.wav,	69.81	steken_F1_v0.wav;	70.37	0.57
248	LoudSoft,	steken_F1_v0.wav,	70.37	haan_F2_v1.wav;	69.81	-0.57
249	SoftLoud,	eikel_TSwe_v1.wav,	70.07	slet_TSwe_v0.wav;	70.68	0.61
250	LoudSoft,	slet_TSwe_v0.wav,	70.68	eikel_TSwe_v1.wav;	70.07	-0.61
251	LoudSoft,	tering_TSwe_v0.wav,	72.70	kikker_TNeu_v1.wav;	66.03	-6.67
252	SoftLoud,	kikker_TNeu_v1.wav,	66.03	tering_TSwe_v0.wav;	72.70	6.67
253	SoftLoud,	wijs_TNeu_v1.wav,	68.64	vilders_F2_v0.wav;	69.62	0.98
254	LoudSoft,	vilders_F2_v0.wav,	69.62	wijs_TNeu_v1.wav;	68.64	-0.98
255	SoftLoud,	jaar_C2Neu_v1.wav,	69.66	Obama_F2_v0.wav;	72.79	3.14
256	LoudSoft,	Obama_F2_v0.wav,	72.79	jaar_C2Neu_v1.wav;	69.66	-3.14
257	LoudSoft,	haat_F1_v0.wav,	70.27	hoi_F1_v1.wav;	69.55	-0.72
258	SoftLoud,	hoi_F1_v1.wav,	69.55	haat_F1_v0.wav;	70.27	0.72
259	SoftLoud,	dik_C2Neu_v1.wav,	65.78	doei_F1_v0.wav;	74.88	9.10
260	LoudSoft,	doei_F1_v0.wav,	74.88	dik_C2Neu_v1.wav;	65.78	-9.10
261	SoftLoud,	dut_TNeu_v1.wav,	67.76	och_F2_v0.wav;	68.03	0.27
262	LoudSoft,	och_F2_v0.wav,	68.03	dut_TNeu_v1.wav;	67.76	-0.27
263	LoudSoft,	ik_F1_v0.wav,	67.57	groepjes_F2_v1.wav;	65.54	-2.04
264	SoftLoud,	groepjes_F2_v1.wav,	65.54	ik_F1_v0.wav;	67.57	2.04
265	LoudSoft,	laan_C2Neu_v0.wav,	71.69	zit_C1Neu_v1.wav;	66.13	-5.55
266	SoftLoud,	zit_C1Neu_v1.wav,	66.13	laan_C2Neu_v0.wav;	71.69	5.55
267	LoudSoft,	laat_C1Neu_v0.wav,	70.00	morsen_C2Neu_v1.wav;	69.60	-0.40
268	SoftLoud,	morsen_C2Neu_v1.wav,	69.60	laat_C1Neu_v0.wav;	70.00	0.40
269	LoudSoft,	smeken_F2_v0.wav,	72.91	groetjes_F1_v1.wav;	64.22	-8.69
270	SoftLoud,	groetjes_F1_v1.wav,	64.22	smeken_F2_v0.wav;	72.91	8.69
271	SoftLoud,	mussen_C2Neu_v1.wav,	70.28	klote_TSwe_v0.wav;	72.09	1.81

272	LoudSoft,	klote_TSwe_v0.wav,	72.09	mussen_C2Neu_v1.wav;	70.28	-1.81
273	LoudSoft,	haar_C2Neu_v0.wav,	70.76	zeker_C1Neu_v1.wav;	69.79	-0.97
274	SoftLoud,	zeker_C1Neu_v1.wav,	69.79	haar_C2Neu_v0.wav;	70.76	0.97
275	SoftLoud,	hoer_TSwe_v1.wav,	68.91	maar_C1Neu_v0.wav;	71.69	2.78
276	LoudSoft,	maar_C1Neu_v0.wav,	71.69	hoer_TSwe_v1.wav;	68.91	-2.78
277	LoudSoft,	gelul_TSwe_v0.wav,	72.09	deel_C2Neu_v1.wav;	69.97	-2.12
278	SoftLoud,	deel_C2Neu_v1.wav,	69.97	gelul_TSwe_v0.wav;	72.09	2.12
279	SoftLoud,	klere_TSwe_v1.wav,	68.52	heel_C1Neu_v0.wav;	71.87	3.35
280	LoudSoft,	heel_C1Neu_v0.wav,	71.87	klere_TSwe_v1.wav;	68.52	-3.35
281	SoftLoud,	weg_C1Neu_v1.wav,	67.41	Osama_F1_v0.wav;	72.66	5.25
282	LoudSoft,	Osama_F1_v0.wav,	72.66	weg_C1Neu_v1.wav;	67.41	-5.25
283	SoftLoud,	das_C2Neu_v1.wav,	64.99	ook_F2_v0.wav;	65.75	0.76
284	LoudSoft,	ook_F2_v0.wav,	65.75	das_C2Neu_v1.wav;	64.99	-0.76
285	LoudSoft,	blote_TNeu_v0.wav,	72.09	geluk_TNeu_v1.wav;	68.21	-3.88
286	SoftLoud,	geluk_TNeu_v1.wav,	68.21	blote_TNeu_v0.wav;	72.09	3.88
287	LoudSoft,	jij_F1_v0.wav,	71.17	neef_TNeu_v1.wav;	70.10	-1.07
288	SoftLoud,	neef_TNeu_v1.wav,	70.10	jij_F1_v0.wav;	71.17	1.07
289	SoftLoud,	veld_C2Neu_v1.wav,	65.49	staan_C2Neu_v0.wav;	72.51	7.02
290	LoudSoft,	staan_C2Neu_v0.wav,	72.51	veld_C2Neu_v1.wav;	65.49	-7.02
291	LoudSoft,	wijf_TSwe_v0.wav,	70.26	hou_F2_v1.wav;	68.65	-1.61
292	SoftLoud,	hou_F2_v1.wav,	68.65	wijf_TSwe_v0.wav;	70.26	1.61
293	LoudSoft,	smet_TNeu_v0.wav,	70.68	geld_C1Neu_v1.wav;	68.02	-2.66
294	SoftLoud,	geld_C1Neu_v1.wav,	68.02	smet_TNeu_v0.wav;	70.68	2.66
295	LoudSoft,	dag_C1Neu_v0.wav,	67.57	Wilders_F1_v1.wav;	67.72	0.14
296	SoftLoud,	Wilders_F1_v1.wav,	67.72	dag_C1Neu_v0.wav;	67.57	-0.14
297	SoftLoud,	lul_TSwe_v1.wav,	70.99	nering_TNeu_v0.wav;	72.72	1.72
298	LoudSoft,	nering_TNeu_v0.wav,	72.72	lul_TSwe_v1.wav;	70.99	-1.72
299	SoftLoud,	klare_TNeu_v1.wav,	69.19	teef_TSwe_v0.wav;	70.91	1.72
300	LoudSoft,	teef_TSwe_v0.wav,	70.91	klare_TNeu_v1.wav;	69.19	-1.72

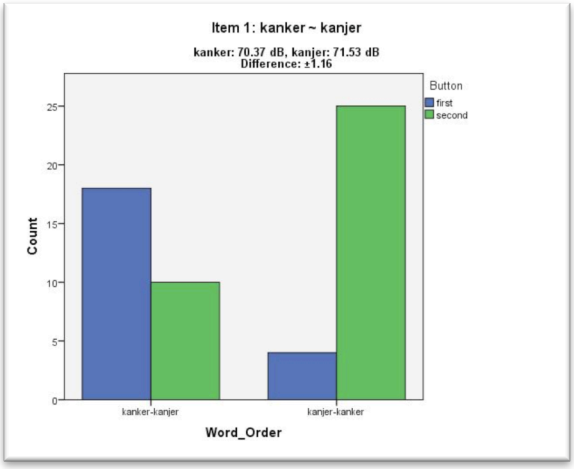
301	SoftLoud,	staat_C1Neu_v1.wav,	66.77	koken_F2_v0.wav;	74.03	7.26
302	LoudSoft,	koken_F2_v0.wav,	74.03	staat_C1Neu_v1.wav;	66.77	-7.26
303	LoudSoft,	kanker_TSwe_v0.wav,	70.37	dit_C1Neu_v1.wav;	65.44	-4.93
304	SoftLoud,	dit_C1Neu_v1.wav,	65.44	kanker_TSwe_v0.wav;	70.37	4.93
305	LoudSoft,	zin_C2Neu_v0.wav,	70.73	kut_TSwe_v1.wav;	65.85	-4.88
306	SoftLoud,	kut_TSwe_v1.wav,	65.85	zin_C2Neu_v0.wav;	70.73	4.88
307	SoftLoud,	nul_TNeu_v1.wav,	69.71	web_C2Neu_v0.wav;	67.22	-2.49
308	LoudSoft,	web_C2Neu_v0.wav,	67.22	nul_TNeu_v1.wav;	69.71	2.49
309	LoudSoft,	Cohen_F1_v0.wav,	74.64	tja_F1_v1.wav;	68.71	-5.93
310	SoftLoud,	tja_F1_v1.wav,	68.71	Cohen_F1_v0.wav;	74.64	5.93
311	LoudSoft,	morgen_C1Neu_v0.wav,	71.59	flikker_TSwe_v1.wav;	66.81	-4.79
312	SoftLoud,	flikker_TSwe_v1.wav,	66.81	morgen_C1Neu_v0.wav;	71.59	4.79

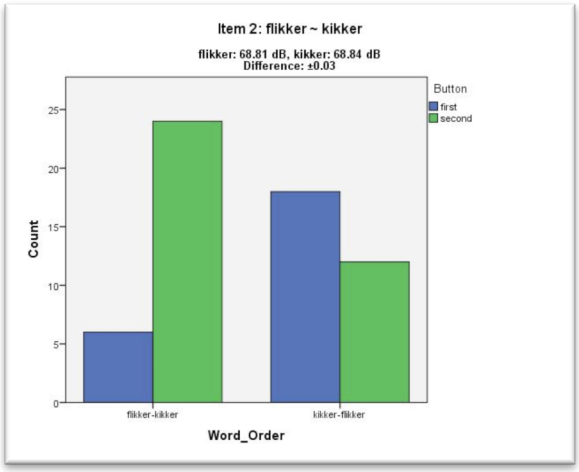
Appendix 1C: Translations

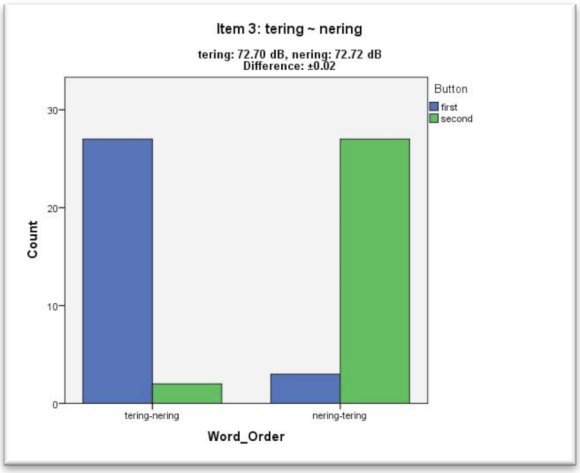
Test items	*Swear*		*Neutral*	
	Dutch	English	Dutch	English
	eikel	acorn, jerk	eiken	oak
	flikker	faggot	kikker	frog
	gelul	bullshit	geluk	happiness
	hoer	whore	boer	farmer
	kanker	cancer	kanjer	whopper
	klere	cholera	klare	ready
	klote	fucking	blote	naked person
	kut	cunt	dut	nap
	lul	dick	nul	zero
	slet	slut	smet	stain
	teef	bitch	neef	nephew
	tering	consumption	nering	commerce
	wijf	bitch	wijs	wise
Control items	*Neutral1*		*Neutral2*	
	Dutch	English	Dutch	English
	daar	haar	haar	hair
	dag	das	das	badger
	dit	dik	dik	thick
	geld	veld	veld	field
	heel	deel	deel	part
	laat	laan	laan	avenue
	maar	jaar	jaar	year
	morgen	morsen	morsen	to spill
	staat	staan	staan	stand (3pl)
	tussen	mussen	mussen	sparrows
	weg	web	web	spider web
	zeker	beker	beker	cup
	zit	zin	zin	sentence
Confound Items	*Confound1*		*Confound2*	
	Dutch	English	Dutch	English
	hoi	hi	hou	love
	doei	bye	boei	bouy
	groetjes	greetings	groepjes	groups
	ach	ah	och	oh
	tja	yeah	mja	but hey

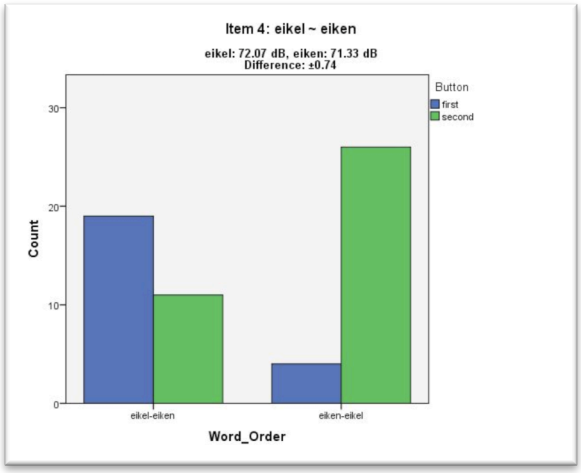
	ik	I	ook	also
	jij	you	zij	she/they
	Wilders	Name	vilders	skinners / painters
	Rutte	Name	putte	depleted
	Cohen	Name	koken	to cook
	Osama	Name	Obama	Name
	haat	hate	haan	rooster
	steken	stab	smeken	to beg

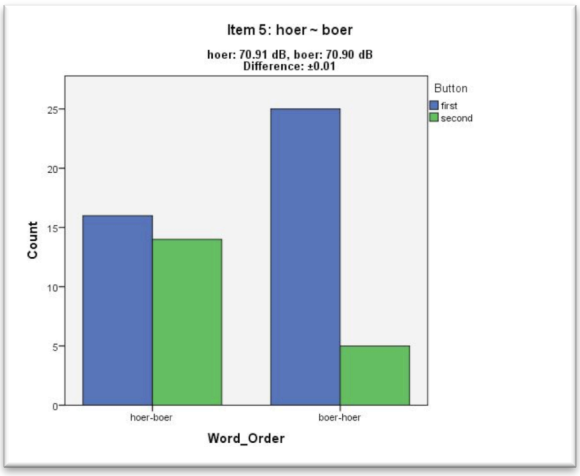
Appendix 2: By-Item Results

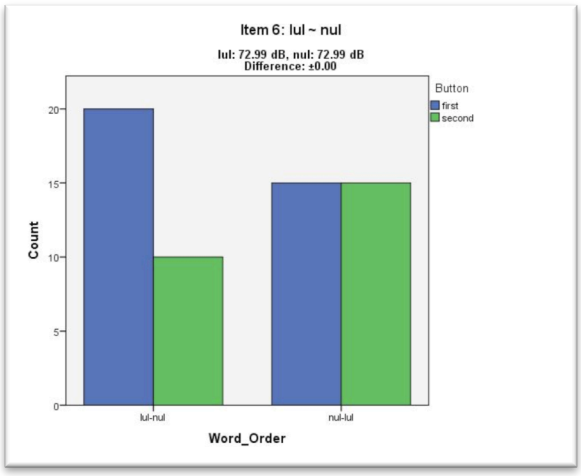


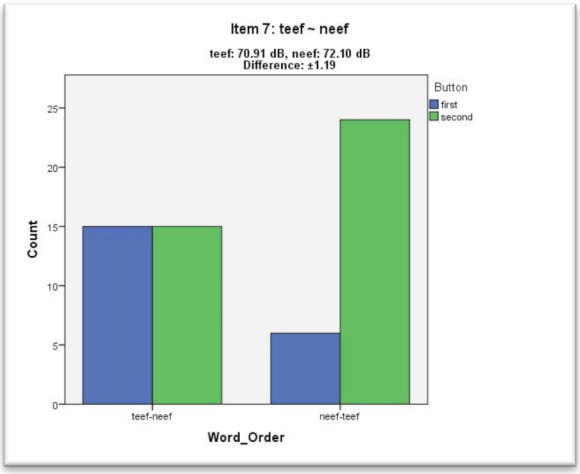


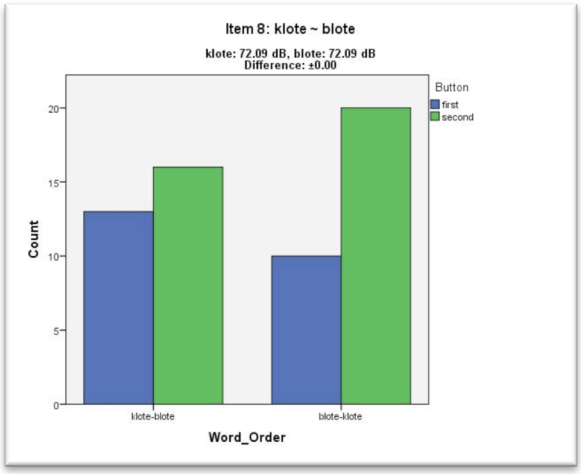


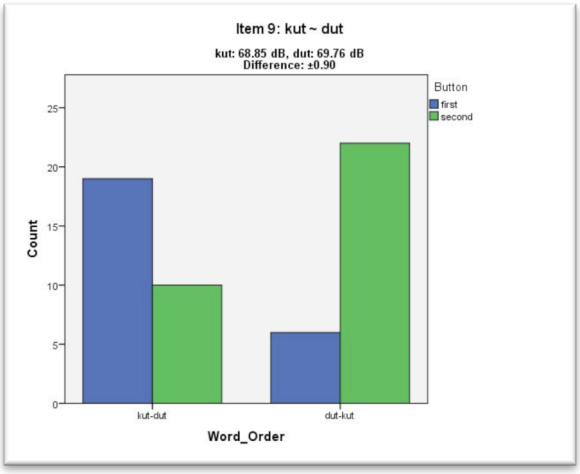


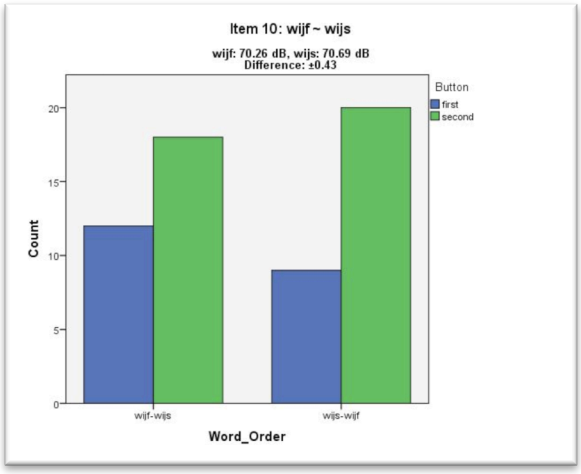


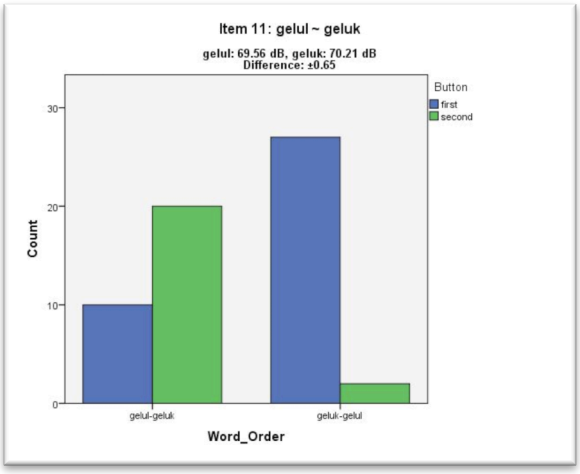


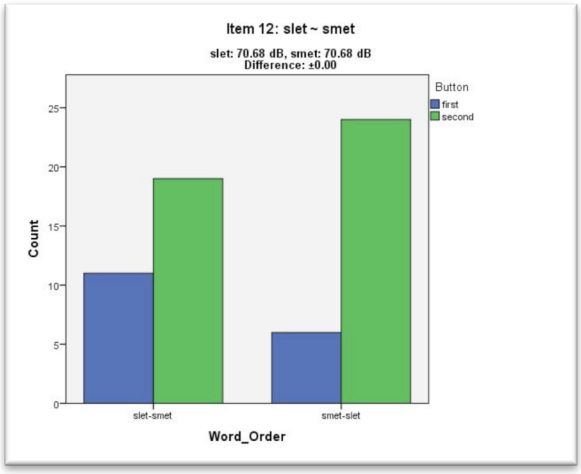

Item 7: teef ~ neef
teef: 70.91 dB, neef: 72.10 dB
Difference: ±1.19
Button
first
second
Count
0
5
10
15
20
25
teef-neef
neef-teef
Word_Order

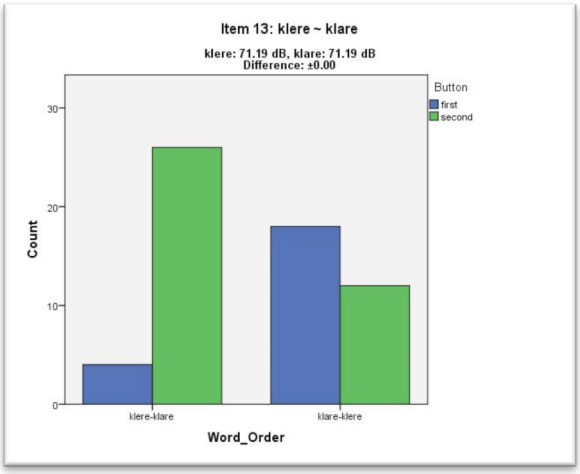

Item 8: klote ~ blote
klote: 72.09 dB, blote: 72.09 dB
Difference: ±0.00
Button
first
second
Count
0
5
10
15
20
klote-blote
blote-klote
Word_Order

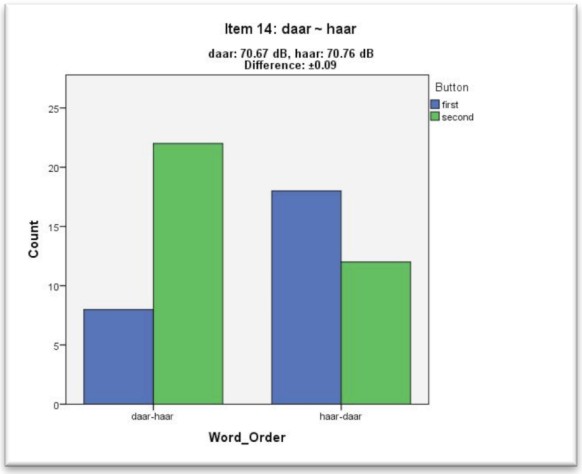

Item 9: kut ~ dut
kut: 68.85 dB, dut: 69.76 dB
Difference: ±0.90
Button
first
second
Count
0
5
10
15
20
25
kut-dut
dut-kut
Word_Order

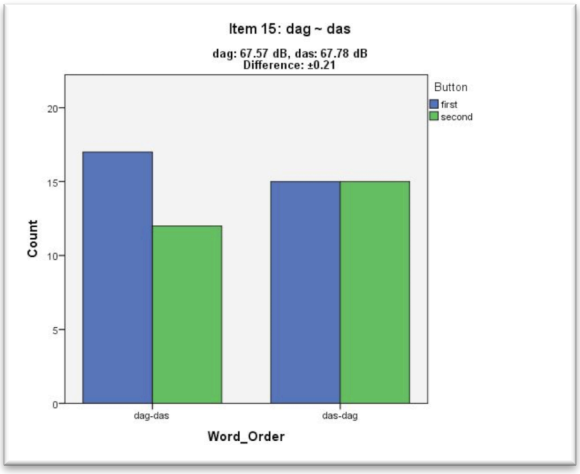

Item 10: wijf ~ wijs
wijf: 70.26 dB, wijs: 70.69 dB
Difference: ±0.43
Button
first
second
Count
0
5
10
15
20
wijf-wijs
wijs-wijf
Word_Order

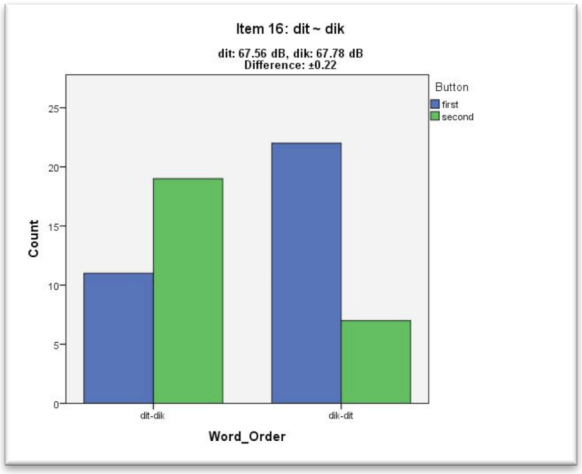

Item 11: gelul ~ geluk
gelul: 69.56 dB, geluk: 70.21 dB
Difference: ±0.65
Button
first
second
Count
0
10
20
30
gelul-geluk
geluk-gelul
Word_Order

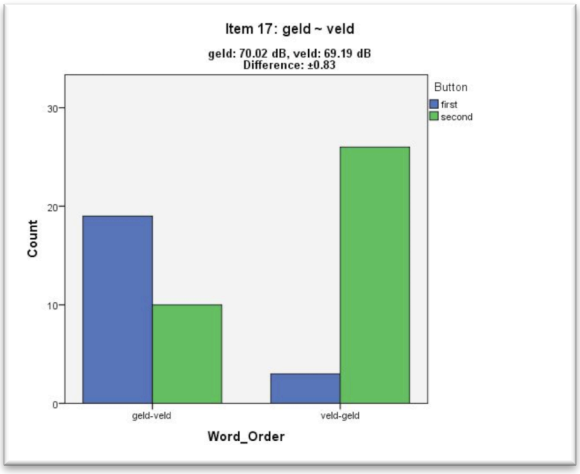

Item 12: slet ~ smet
slet: 70.68 dB, smet: 70.68 dB
Difference: ±0.00
Button
first
second
Count
0
5
10
15
20
25
slet-smet
smet-slet
Word_Order

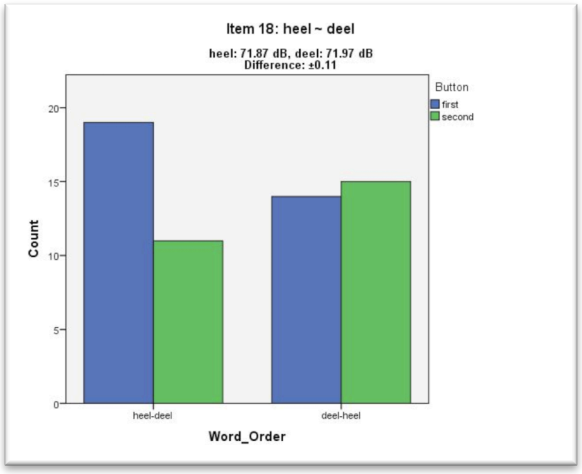

Item 13: klere ~ klare
klere: 71.19 dB, klare: 71.19 dB
Difference: ±0.00
Button
first
second
Count
0
10
20
30
klere-klare
klere-klere
Word_Order

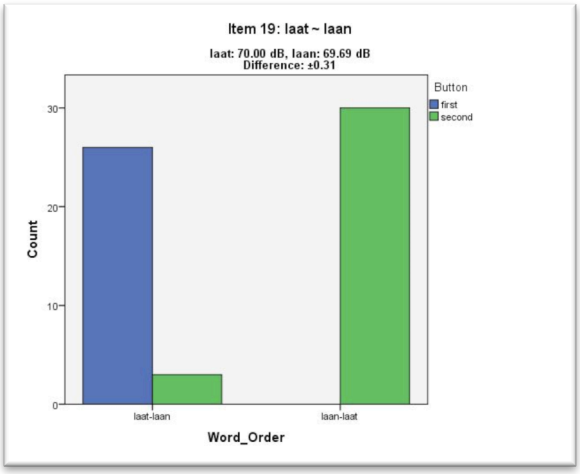

Item 14: daar ~ haar
daar: 70.67 dB, haar: 70.76 dB
Difference: ±0.09
Button
first
second
Count
0
5
10
15
20
25
daar-haar
haar-daar
Word_Order

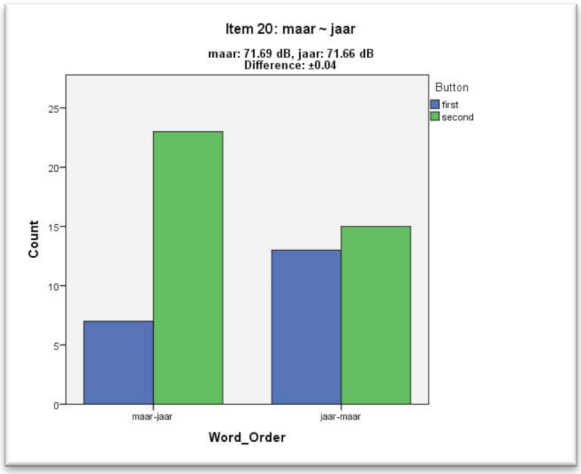

Item 15: dag ~ das
dag: 67.57 dB, das: 67.78 dB
Difference: ±0.21
Button
first
second
Count
0
5
10
15
20
dag-das
das-dag
Word_Order


Item 16: dit ~ dik
dit: 67.56 dB, dik: 67.78 dB
Difference: ±0.22
Button
first
second
Count
0
5
10
15
20
25
dit-dik
dik-dit
Word_Order

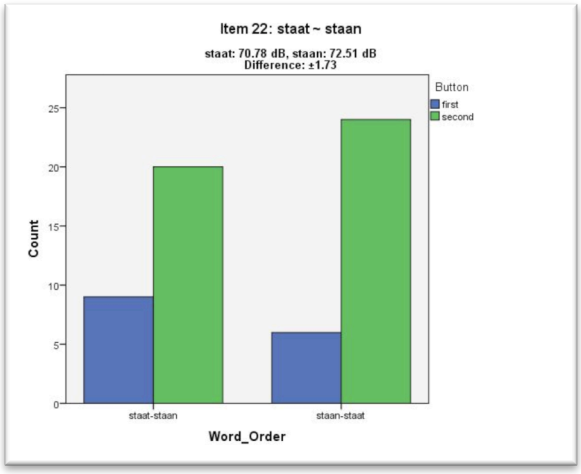

Item 17: geld ~ veld
geld: 70.02 dB, veld: 69.19 dB
Difference: ±0.83
Button
first
second
Count
0
10
20
30
geld-veld
veld-geld
Word_Order

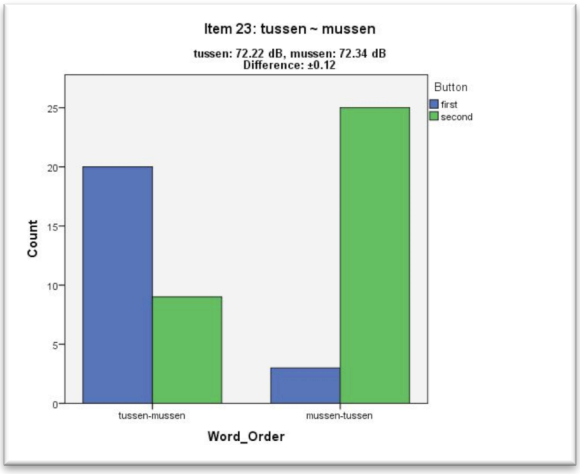

Item 18: heel ~ deel
heel: 71.87 dB, deel: 71.97 dB
Difference: ±0.11
Button
first
second
Count
0
5
10
15
20
heel-deel
deel-heel
Word_Order

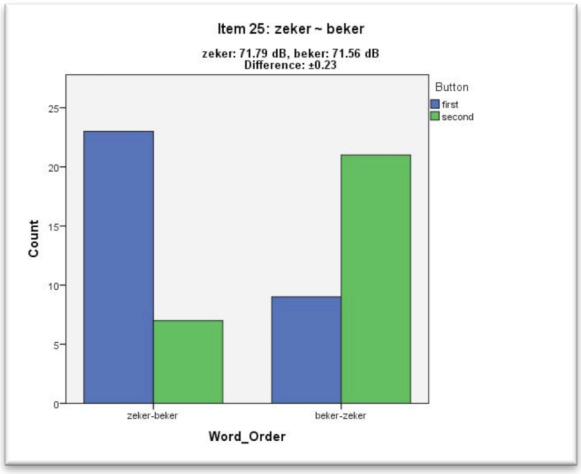

Item 19: laat ~ laan
laat: 70.00 dB, laan: 69.69 dB
Difference: ±0.31
Button
first
second
Count
0
10
20
30
laat-laan
laan-laat
Word_Order


Item 20: maar ~ jaar
maar: 71.69 dB, jaar: 71.66 dB
Difference: ±0.04
Button
first
second
Count
0
5
10
15
20
25
maar-jaar
jaar-maar
Word_Order

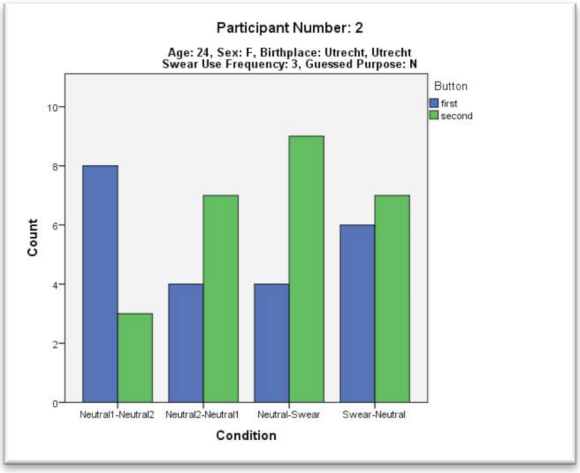

Item 21: morgen ~ morsen
morgen: 71.59 dB, morsen: 71.60 dB
Difference: ±0.01
Button
first
second
Count
0
5
10
15
20
morgen-morsen
morsen-morgen
Word_Order

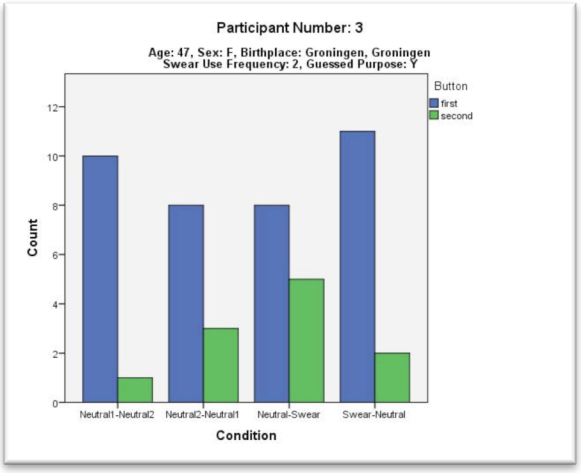

Item 22: staat ~ staan
staat: 70.78 dB, staan: 72.51 dB
Difference: ±1.73
Button
first
second
Count
0
5
10
15
20
25
staat-staan
staan-staat
Word_Order

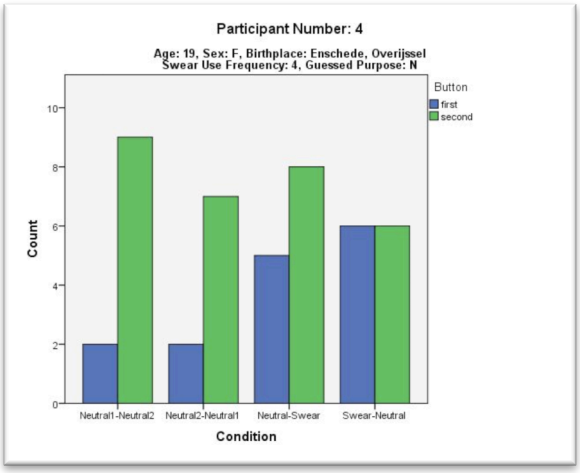

Item 23: tussen ~ mussen
tussen: 72.22 dB, mussen: 72.34 dB
Difference: ±0.12
Button
first
second
Count
0
5
10
15
20
25
tussen-mussen
mussen-tussen
Word_Order

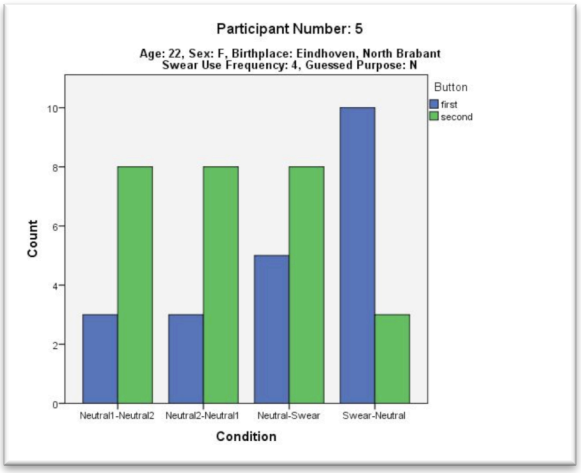

Item 25: zeker ~ beker
zeker: 71.79 dB, beker: 71.56 dB
Difference: ±0.23
Button
first
second
Count
0
5
10
15
20
25
zeker-beker
beker-zeker
Word_Order

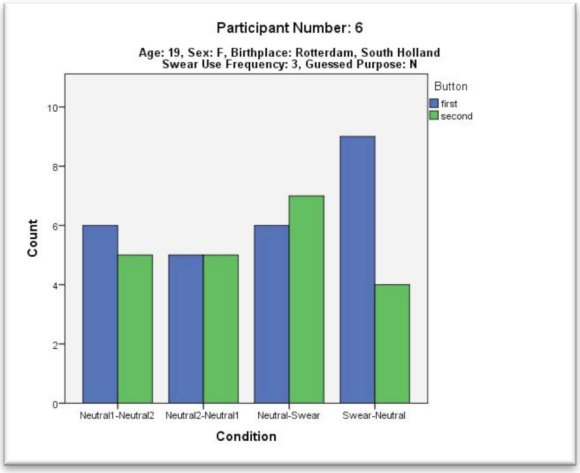
Appendix 3: By-Participant Results

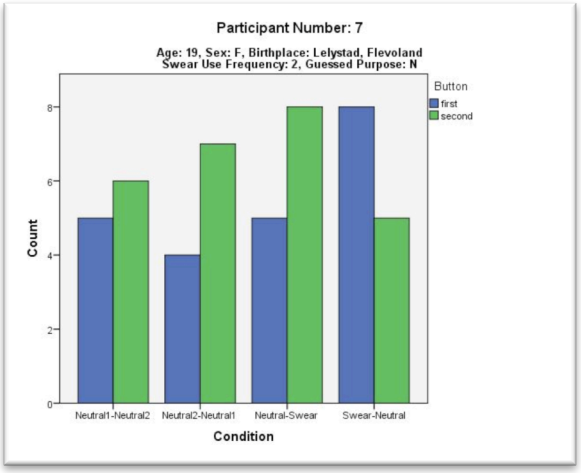


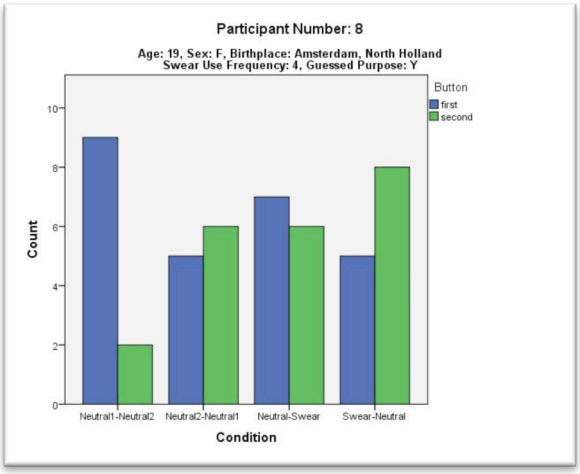


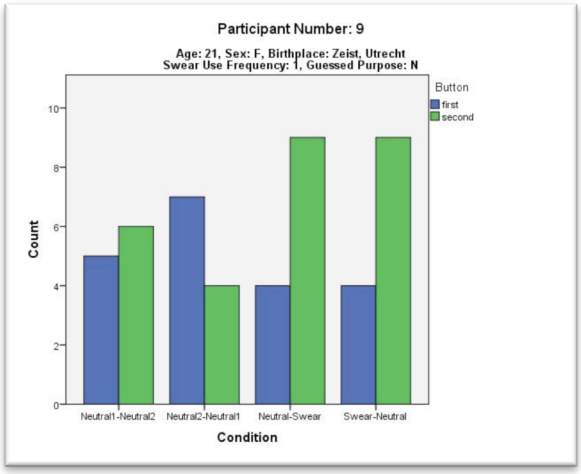


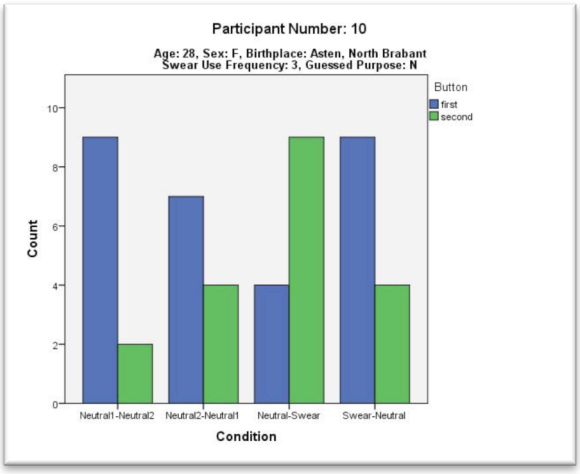


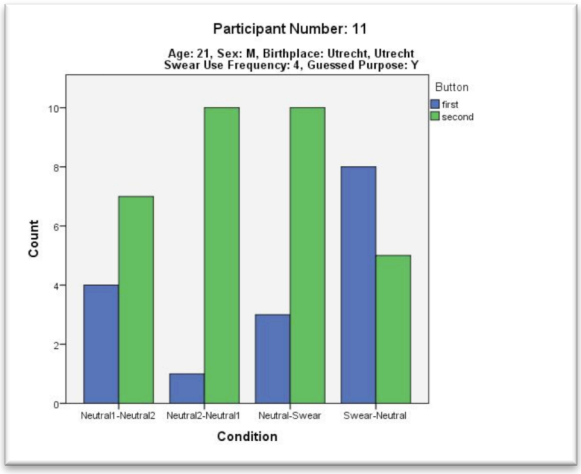


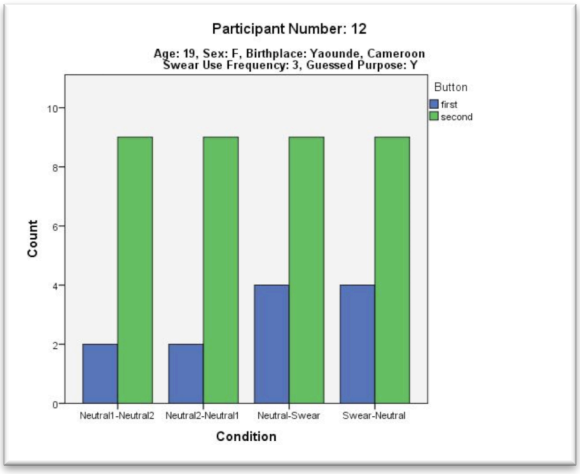


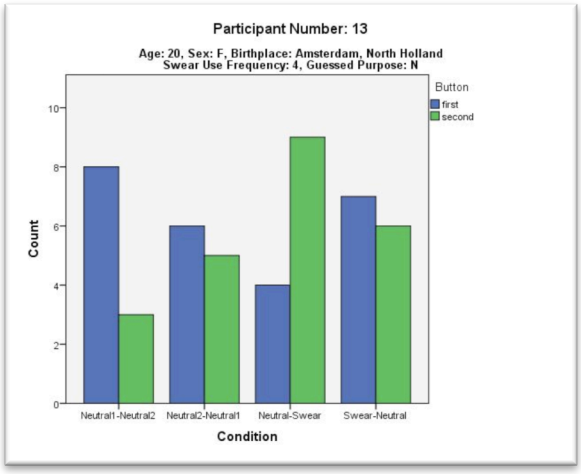

Participant Number: 8
Age: 19, Sex: F, Birthplace: Amsterdam, North Holland
Swear Use Frequency: 4, Guessed Purpose: Y
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

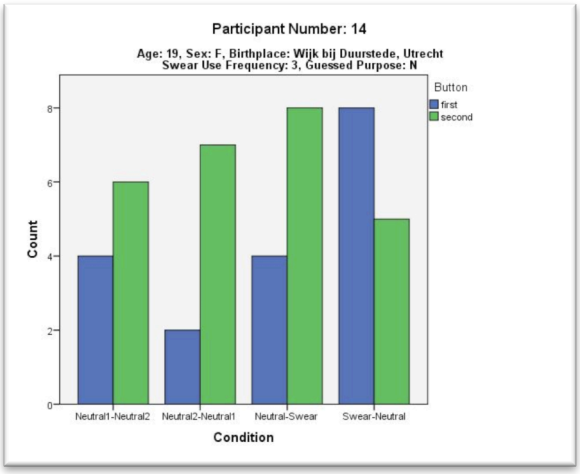

Participant Number: 9
Age: 21, Sex: F, Birthplace: Zeist, Utrecht
Swear Use Frequency: 1, Guessed Purpose: N
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

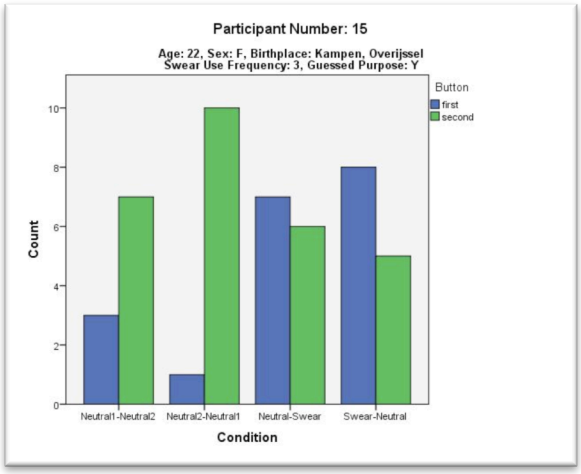

Participant Number: 10
Age: 28, Sex: F, Birthplace: Asten, North Brabant
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

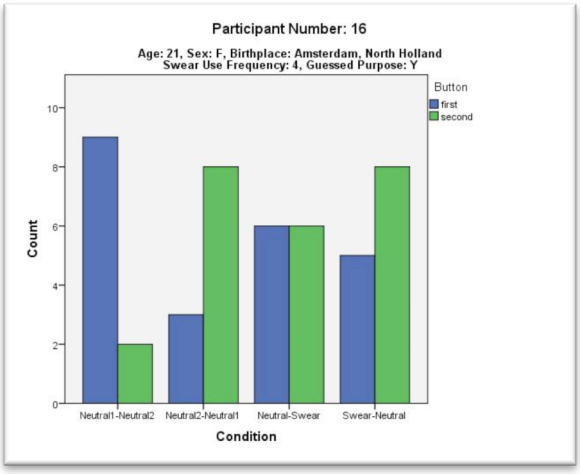

Participant Number: 11
Age: 21, Sex: M, Birthplace: Utrecht, Utrecht
Swear Use Frequency: 4, Guessed Purpose: Y
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

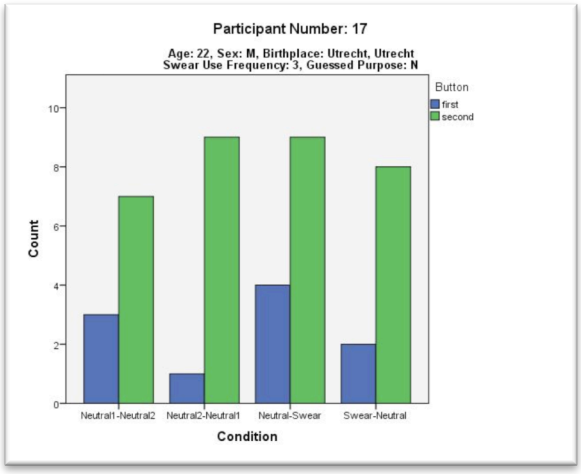

Participant Number: 12
Age: 19, Sex: F, Birthplace: Yaounde, Cameroon
Swear Use Frequency: 3, Guessed Purpose: Y
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

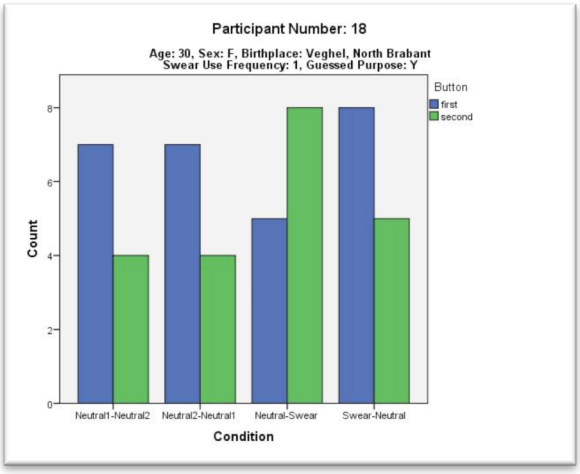

Participant Number: 13
Age: 20, Sex: F, Birthplace: Amsterdam, North Holland
Swear Use Frequency: 4, Guessed Purpose: N
Button
first
second
Count
0
2
4
6
8
10
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

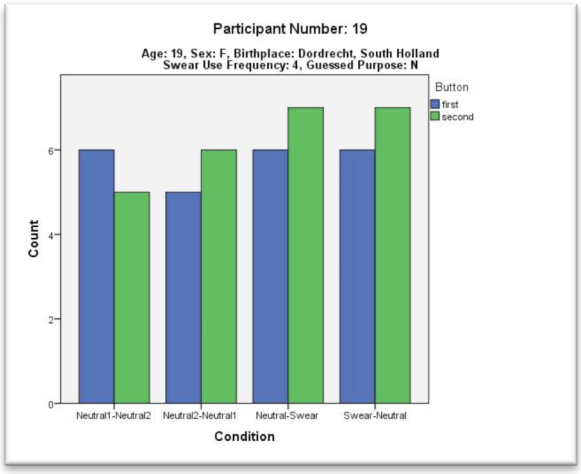

Participant Number: 14
Age: 19, Sex: F, Birthplace: Wijk bij Duurstede, Utrecht
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

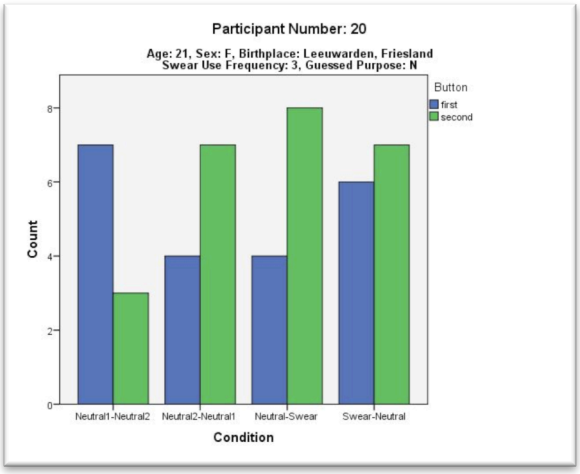

Participant Number: 15
Age: 22, Sex: F, Birthplace: Kampen, Overijssel
Swear Use Frequency: 3, Guessed Purpose: Y
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

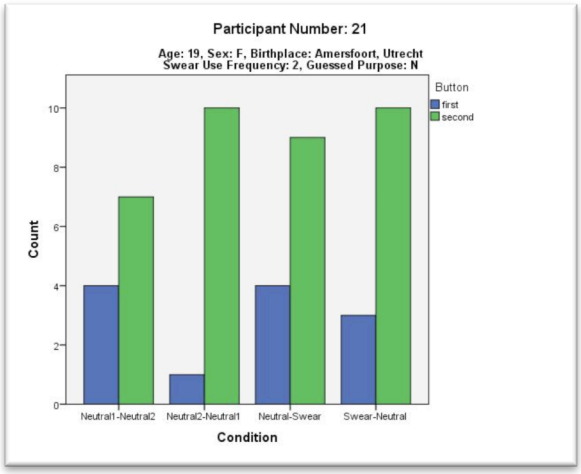

Participant Number: 16
Age: 21, Sex: F, Birthplace: Amsterdam, North Holland
Swear Use Frequency: 4, Guessed Purpose: Y
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

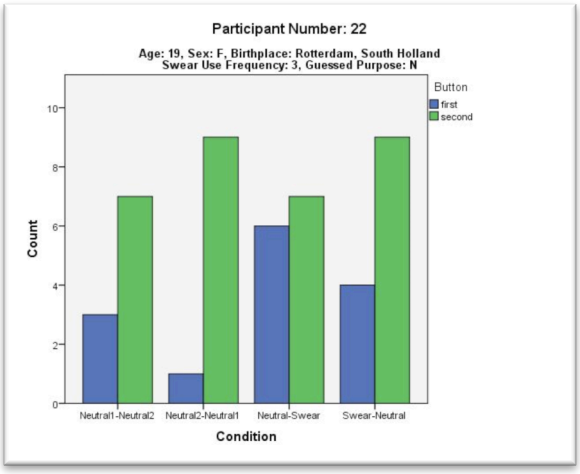

Participant Number: 17
Age: 22, Sex: M, Birthplace: Utrecht, Utrecht
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

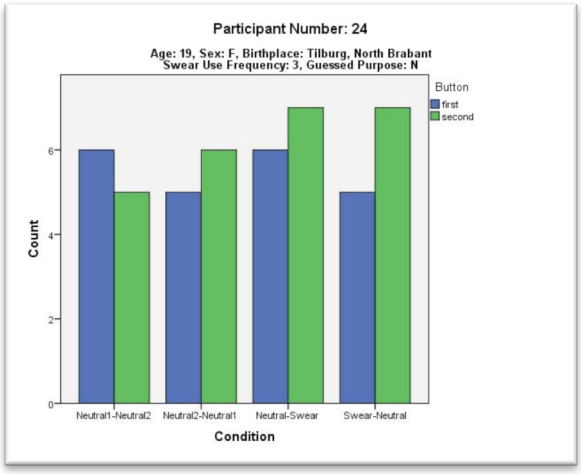

Participant Number: 18
Age: 30, Sex: F, Birthplace: Veghel, North Brabant
Swear Use Frequency: 1, Guessed Purpose: Y
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

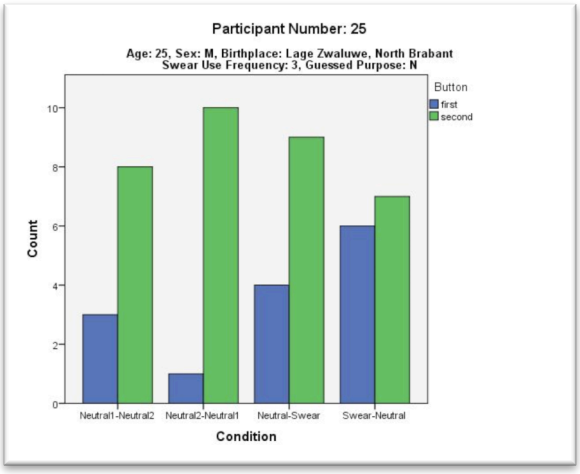

Participant Number: 19
Age: 19, Sex: F, Birthplace: Dordrecht, South Holland
Swear Use Frequency: 4, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

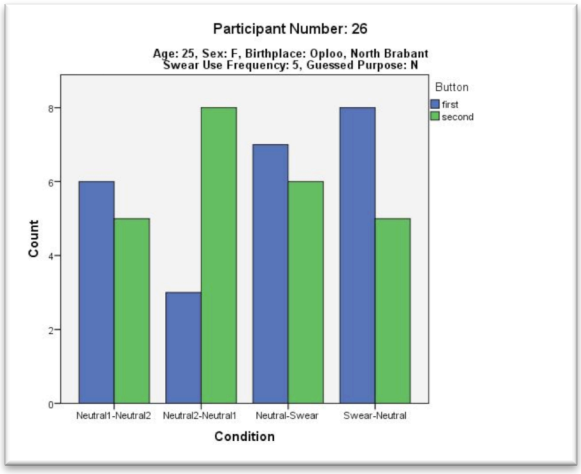

Participant Number: 20
Age: 21, Sex: F, Birthplace: Leeuwarden, Friesland
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

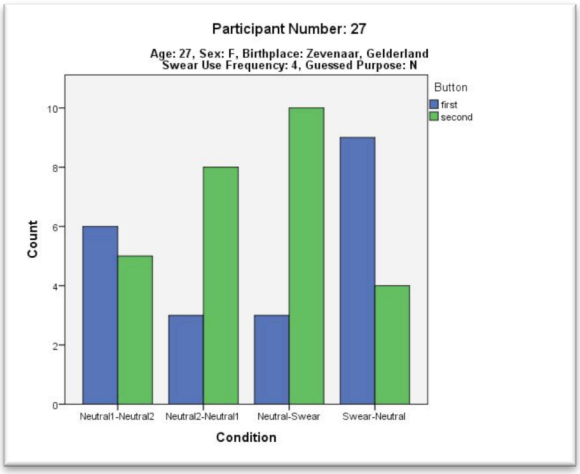

Participant Number: 21
Age: 19, Sex: F, Birthplace: Amersfoort, Utrecht
Swear Use Frequency: 2, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

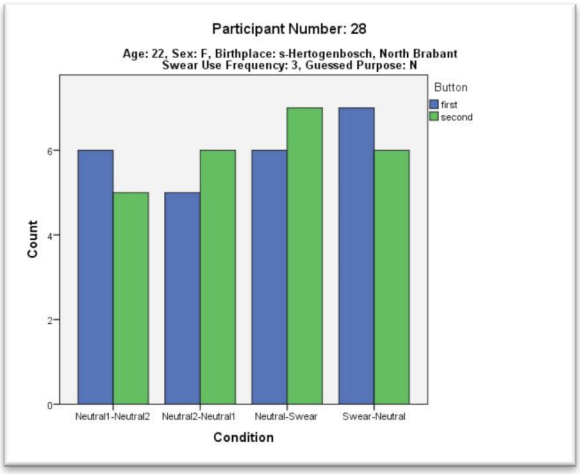

Participant Number: 22
Age: 19, Sex: F, Birthplace: Rotterdam, South Holland
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

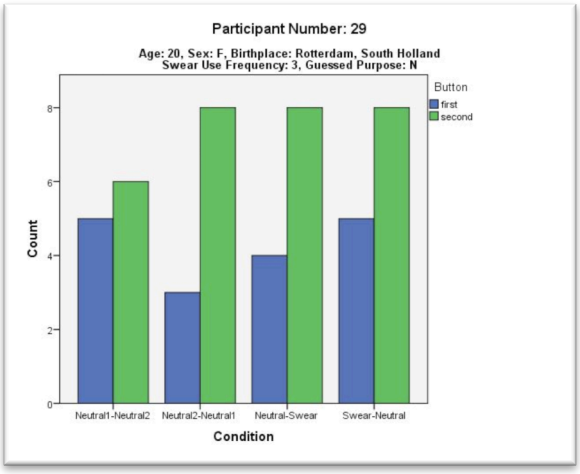

Participant Number: 24
Age: 19, Sex: F, Birthplace: Tilburg, North Brabant
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

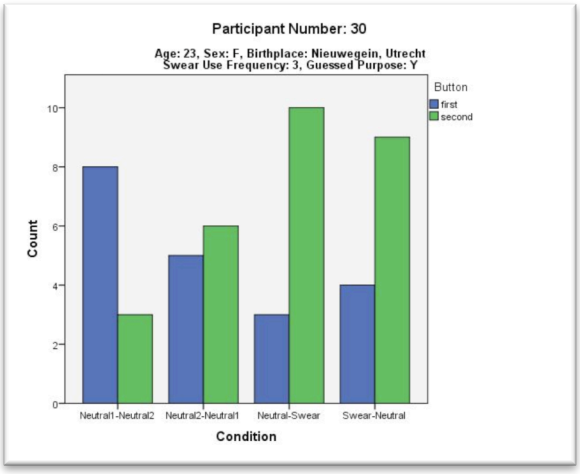

Participant Number: 25
Age: 25, Sex: M, Birthplace: Lage Zwaluwe, North Brabant
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

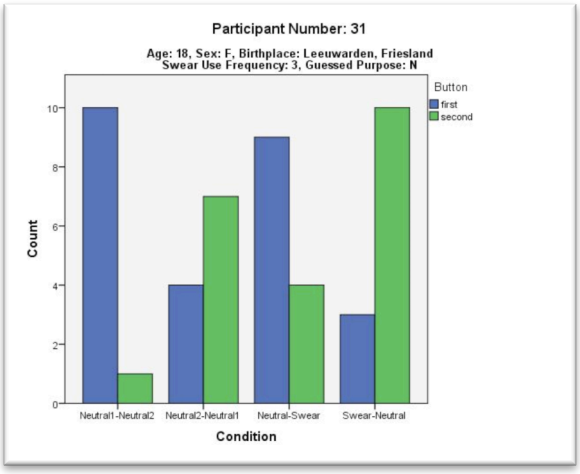

Participant Number: 26
Age: 25, Sex: F, Birthplace: Oploo, North Brabant
Swear Use Frequency: 5, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

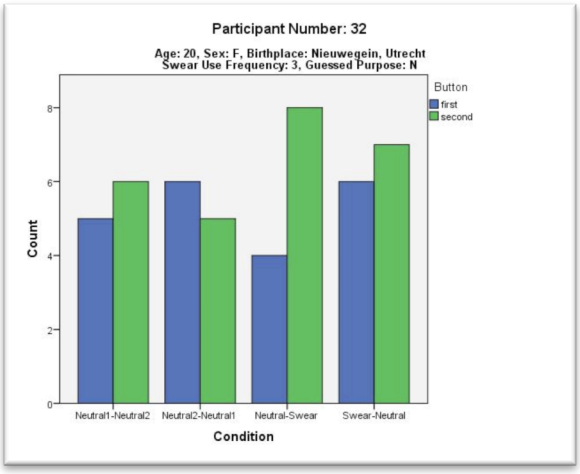

Participant Number: 27
Age: 27, Sex: F, Birthplace: Zevenaar, Gelderland
Swear Use Frequency: 4, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition


Participant Number: 28
Age: 22, Sex: F, Birthplace: s-Hertogenbosch, North Brabant
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition


Participant Number: 29
Age: 20, Sex: F, Birthplace: Rotterdam, South Holland
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition


Participant Number: 30
Age: 23, Sex: F, Birthplace: Nieuwegein, Utrecht
Swear Use Frequency: 3, Guessed Purpose: Y
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition


Participant Number: 31
Age: 18, Sex: F, Birthplace: Leeuwarden, Friesland
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition


Participant Number: 32
Age: 20, Sex: F, Birthplace: Nieuwegein, Utrecht
Swear Use Frequency: 3, Guessed Purpose: N
Button
first
second
Count
Neutral1-Neutral2
Neutral2-Neutral1
Neutral-Swear
Swear-Neutral
Condition

Appendix 4: Participant Questionnaire

Deelnemernummer _____ Leeftijd _____ Geslacht M / V

Woonplaats _____

Geboorteplaats _____

1. Hoe vaak gebruik je vloekwoorden in je alledaagse gesprekken? (omcirkel je antwoord)

1----------2----------3----------4----------5
nooit | bijna nooit | soms | vaak | heel vaak

2. In een normaal gesprek, hoe sterk / aanstootgevend vind je de volgende woorden? (omcirkel je antwoord)

eikel

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

flikker

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

gelul

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

hoer

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

kanker

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

klere

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

klote

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

kut

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

lul

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

slet

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

teef

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

tering

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

wijf

1----------2----------3----------4----------5
helemaal niet | een beetje | nogal | tamelijk veel | erg veel

3. Hoeveel procent van de paren die je hebt gehoord, bevatte volgens jou een van deze woorden? _____