EFFECT OF SYNTACTIC STRUCTURE ON SPEECH PRODUCTION IN ADULTS WHO STUTTER

By

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To my parents: Atef Haj-Tas and Samiya Hakouz.

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This study examined (a) the effect of syntactic structure on speech fluency and speech reaction time (SRT) in adults who stutter, (b) the effect of syntactic priming on fluency in those participants. Fourteen persons who stutter (PWS) and fourteen persons who do not stutter (PWNS) participated in the study. A sentence structure priming paradigm was used to elicit sentences of varying syntactic forms (i.e., transitive, dative, and two-clause).

The results of the fluency analyses indicated that (a) PWS produced significantly more 'repetitions and prolongations' per response than PWNS, (b) all participants produced a comparable number of 'other' types of disfluencies (e.g., interjections and revisions), (c) all participants seemed to produce more fluent responses following transitive pictures and fewer fluent responses following two-clause pictures.

The results of the priming analyses indicated that (a) the presence of passive primes did not significantly increase the probability of using passives in the response, (b) the structure of the dative primes affected the probability of using those structures in the response differently between the study groups. Specifically, the PWS produced significantly more prepositional-dative responses following prepositional dative primes than following object-complement primes; however, no significant differences among the effect were observed in the PWNS. This

finding was taken to suggest that priming dative sentence forms for the PWNS might be more driven by the structural aspects of the available options and for the PWS by the thematic aspects, and (c) the presence of the embedded primes did not significantly increase the probability of using embedded structures in the responses.

The results of the SRT analyses indicated (a) no significant differences between the two groups in SRT, (b) that the syntactic structure of the response did not affect SRT differently between the two groups, and (c) all participants produced transitive responses at a significantly shorter SRT than dative responses, and dative responses at a significantly shorter SRT than two-clause responses. The results of the SRT were taken to suggest that increasing the syntactic complexity of the responses may influence the time both the PWS and the PWNS may need to generate such responses.

CHAPTER 1
INTRODUCTION

The relationship between speech formulation processes and stuttering has been central to numerous hypotheses and investigations for several decades. A number of models of stuttering suggest stuttering is a problem that results from difficulties arising during speech formulation, that is, prior to speech production (e.g., Kolk & Postma, 1997; Perkins, Kent, & Curlee, 1991; Starkweather, 1987). Results of numerous studies also provide evidence that increased linguistic, temporal, and cognitive loads seem to affect the speed and fluency of speech production in persons who stutter (PWS) more so than it does in persons who do not stutter (PWNS) (e.g., Bernstein Ratner & Sih, 1986; Bosshardt, 1993; Bosshardt & Fransen, 1996; Cuadrado & Weber-Fox, 2003; Logan & Conture, 1995, 1997; Logan, 2001, 2003; Silverman & Ratner, 1997; Yaruss, 1999). Despite all this evidence, there are still numerous unanswered questions about the role that speech formulation plays in the disfluencies that characterize stuttered speech. The present study was conducted to examine the role that syntax might play in speech production in general, and speech fluency and speech timing in specific in PWS.

The plan of this chapter is as follows: Section I provides an overview of a number of psycholinguistic models that offer different perspectives about the cause of stuttering. Section II provides a review of empirical evidence that supports the effect of certain linguistic variables, namely syntactic encoding, on the efficiency and timing of speech formulation processes in PWS. Section III presents a number of methodological limitations associated with previous research that has explored the effect of syntax on speech production processes in PWS. Section IV reviews a methodology (i.e., syntactic priming) that has been used to examine speech formulation processes in both speakers with typical language and speakers with atypical language functioning, and which has only been used infrequently to examine speech formulation

processes in PWS. Finally, section V presents the rationale for using the syntactic priming methodology to examine the syntactic encoding abilities in and between PWS and PWNS.

Psycholinguistic Models of Stuttering: An overview

Numerous models of speech production suggest that different aspects of speech formulation might be involved in the production of disfluencies by PWS (for a review see Bernstein Ratner, 1997; Conture 2001*)*. Such models seem to have a common underlying claim that disfluencies produced by PWS result from disruptions in linguistic planning prior to speech production (Karniol, 1995; Kolk & Postma, 1997; Perkins, Kent, & Curlee, 1991; Smith & Kelly, 1997, Starkweather, 1987). In this section, I provide an overview of the five best-developed models of speech production that researchers have used in their investigations of linguistic planning abilities of PWS.

The Covert Repair Hypothesis (CRH)

Developed by Postma and Kolk (1993), this theory proposes that fluency breakdowns in stuttering result from difficulties that arise prior to speaking in general and at the phonological encoding level in specific. The CRH suggests that although the self-repair process and speech production monitoring skills in PWS are similar to those in typical speakers, the processes underlying the selection of phonemes or insertion of the selected phonemes into speech plans are slower or delayed in PWS compared to PWNS. This “slowness” in phoneme activation or encoding results in particular phonemes being in competition for selection with other phonemes for a time frame longer than normal, which in turn increases the chance of phoneme selection errors if the speaker attempts to commence speaking before the phoneme selection process is complete.

According to the CRH, stuttering arises when PWS detect such selection errors and try to correct them while speaking at a rate that is faster than their impaired phonological encoding

mechanisms allow them to proceed. Within this view, the repetitions and prolongations observed in the speech of PWS are a result of attempts by those speakers to self repair the errors before they are spoken (i.e., covertly repair those errors). In Conture's (2001) review of the CRH, he explained that although this hypothesis has several components that make it appealing (e.g., "attempting to account for speech disfluencies that arise during conversational speech"), the CRH does not account for other levels of speech formulation such as lexical/semantic and syntactic encoding. Thus, as Conture suggested, the CRH "may have limited ability to handle the sort of individual variations that other models so aptly attempt to describe." (p.37)

The Neuropsycholinguistic Theory of Stuttering

Developed by Perkins, Kent, and Curlee (1991), this theory suggests that stuttering results from dyssynchrony in the integration of linguistic units into their planned speech frames. Specifically, the theory suggests that during speech formulation, stuttering occurs if the generation of sounds or "fillers" and the integration of those fillers into syllable frames (or slots) become dyssynchronous. Perkins et al. (1991) explained that hesitations during speech are expected to arise as a result of interactions between uncertainties about the planned linguistic unit and the need for the speaker to "begin, continue, or accelerate an utterance" (p.734). Within such a framework, nonstuttered disfluencies such as revisions and interjections could occur when (a) a speaker is under time pressure and the cause of disfluency such as the speaker's uncertainty about the linguistic characteristics of the target is known, or (b) when the speaker does not know the cause of uncertainty but is not under time pressure. On the other hand, stutter-like disfluencies (e.g., repetitions and audible and inaudible prolongations of sounds and syllables) may occur under the combination of two "primary conditions" (a) when disfluencies could arise from a variety of causes and the speaker is not certain about which cause is contributing to them, and (b) if the speaker is under real or perceived pressure to continue speaking when such

disruptions occur. Within this framework, Perkins et al. (1991) define stuttering as "disruption of speech that is experienced by the speaker as a loss of control" (p.734). Thus, time pressure is a central component in stuttering within this theory's framework.

The Suprasegmental Alignment Model of Stuttering

Developed by Karniol (1995), this model suggests that stuttering results from problems at the speech formulation level. Unlike Kolk et al. (1993) and Perkins et al.'s (1991) models of stuttering, Karniol suggested that stuttering arises from difficulties at the sentence level. The suprasegmental alignment model proposes that disfluencies produced by both PWS and PWNS result from the attempt of the speakers to revise sentence plans during online sentence production. Within such a perspective, Karniol explained that suprasegmental features of a sentence such as rhythm and stress "are largely determined prior to utterance initiation and are expressed through changes in muscle movements" (p.111). Additionally, and as Karniol explained, although suprasegmental features are prepared before the sentence is uttered, speakers often change their speech plans online. Such changes most often occur because speakers may initiate speech before the utterance planning process (especially that for the verb phrase) has been completed. If problems arise during speaking and the utterance cannot be completed as originally planned, speakers may change those plans. Karniol suggests that both the latencies and hesitations observed in speech production reflect such sentence plan changes. In some sense, Karniol's model is similar to Perkins et al.'s model in that both propose that increased demands (such as the need to continue talking while attempting to correct selection errors under time pressure) are important contributors to the transformation of disfluencies into "stuttering events".

The Demands and Capacities Model of Stuttering (DCM)

This model provides yet another view of the processes that lead to stuttered speech (e.g. Starkweather, 1987). Similar to Perkins et al. neuropsycholinguistic model, the DCM suggests

that increased demands affect speech production in PWS. The central claim in the DCM model is that stuttering (specifically in children) may result from demands within or between domains that exceed the capacities of the speaker to produce speech fluently (for a review and critique of the model, see Bernstein Ratner, 1997; Conture, 2001; Manning, 2000; Siegel, 2000, Yaruss, 1999, 2000). Much of the available critique of this model argues that although it is very appealing, the nature and level of demands are not well defined in the model. Some authors, however, provide their own interpretation of the claims of the DMC and suggest examples that may help better understand the nature of such demands. For example, in his review of this model, Conture (2001) provided one example to show how the assumptions of this model work during speech. In his example, Conture explained that although a speaker may have typical (or above average) capacities for generating utterances that are long or grammatically complex, these capacities might be challenged under some conditions, such as when the speaker attempts to rapidly produce long or grammatically complex utterances that may contain complex articulatory adjustments. Within the framework of the DCM, such time pressure demands may exceed the speaker's ability to make the speech motor adjustments needed to accurately and efficiently produce such utterances, and this in turn increases the probability of stuttering.

The Multifactorial Model of Stuttering

Developed by Smith and Kelly (1997), this model provides yet another view of the factors underlying stuttering and suggests that stuttering results from factors that interact in a complex, nonlinear, and dynamic manner. Smith and Kelly explained that stuttered events should not be viewed as static behaviors that occur in isolation at discrete points in time. Rather, stuttered events should be examined within a multifactorial framework in which interactions among various important factors are analyzed. The model also suggests that definitions and descriptions of stuttering need to take into account the reality that the nature of the interactions among factors

will likely vary from one context to another and will also vary between speakers. The Smith et al. model seems to be similar to the other models reviewed in this section in the sense that all of the previously reviewed models suggest that, in one way or another, stuttered speech could result from interactions between two or more factors. The appeal of Smith and Kelly's model is in the fact that it does not confine the cause of stuttering to just one factor and that it considers the variability of stuttering under different conditions. Also, and as Conture (2001) suggests in his review of this model, "The Smith and Kelly model does a nice job of pointing out that individual variations among different variables may mean that we should be talking about causes rather than the cause of stuttering." (p.33).

Although the models reviewed above adopt different approaches in their attempt to explain the factors underlying stuttering, in one way or another, they all seem to suggest that stuttering might result from difficulties that arise during language formulating and prior to speech production. As Conture (2001) suggested, such models may lead us to conclude that some of the factors underlying stuttering "might be found between thought and motor execution of that thought" (p. 354). Although other factors such as motor execution have been implicated in stuttering, Conture suggested that the components of speech production processes above the motor execution level such as semantic, phonological, and syntactic components are "fast enough and creative enough to account for what we know about stuttering" (p.354). Indeed, numerous studies have examined the relationship between speech formulation processes and stuttering and results of several of those studies suggest that such a relationship might exist. The following section provides a review of those studies and the main findings they reported. In addition, the section provides evidence from studies with both children and adults who stutter

about the effect of different linguistic factors in general and the effect of grammatical or syntactic complexity in specific on speech fluency in those speakers.

Linguistic Factors and Stuttering

Empirical evidence from numerous studies has consistently shown that mechanisms underlying language formulation processes such as phonological, semantic, and syntactic encoding may operate atypically in PWS compared to their non stuttering peers (Bernstein Ratner, 1997; Bosshardt, 1993; Bosshardt & Fransen, 1996; Cuadrado & Weber-Fox, 2003; Kolk & Postma, 1997; Wijnen & Boers, 1994; Weber-Fox, Spencer, Spruil, and Smith, 2004). Although on one hand results of several such studies suggest that PWS on average perform within the normal range on static, offline measures of linguistic abilities (e.g., Nippold,1990; Watkins, Yairi, & Ambsrose, 1999), on the other hand, results of numerous studies suggest that the combination of a "fragile" linguistic system and a variety of linguistic and cognitive factors may result in subtle differences between PWS and PWNS during online speech processing (Bernstein Ratner, 1997; Bosshardt, 1993; Bosshardt & Fransen, 1996; Cuadrado & Weber-Fox, 2003; Weber-Fox, Spencer, Spruil, & Smith, 2004).

Although different linguistic processes involved in speech production in PWS have been examined thus far, the contribution of grammatical or syntactic complexity has received most of the attention during the past years. Specifically, many investigations have been conducted to examine the nature of syntactic events that contribute to stuttering and the effect of manipulating such events on speech fluency and accuracy in PWS. In the following section, a brief review will be provided of the main findings of such investigations.

Research on the location and frequency of disfluencies within utterances produced by speakers who stutter indicate that disfluent events do not occur randomly during speech. Specifically, and as Peters and Guitar (1991) explained, "Stuttering occurs more often at points

in the utterance that can be described in linguistic terms." (p.117). For example, results with PWS have consistently shown that stuttering tends to be observed more often on (a) sounds in the word-initial position rather than sounds in other word positions, (b) consonants rather than vowels, (c) multisyllable words rather than monosyllable words, (d) content words (e.g., nouns, verbs, adjectives, adverbs) rather than function words (e.g., articles, prepositions, and pronouns), (e) stressed syllables rather than unstressed syllables, (f) low frequency words rather than high frequency words, and (f) words occurring at or near the sentence initial position rather than sentence final position (for more information, see reviews in Bloodstein, 1995; Bernstein Ratner, 1997; Peters & Guitar, 1991).

Results of numerous studies have also shown that in children who stutter (CWS), stuttering is more likely to occur within utterances that are long and/or syntactically complex than utterances that are short and/or syntactically simple (e.g., Bernstein Ratner and Sih, 1987; Gaines, Runyan, & Meyers, 1991; Gordon, Luper, & Peterson, 1981; Logan & Conture, 1995; 1997; Wall, Starkweather, & Cairns, 1981; Yaruss, 1999). In general, these results have been interpreted within theoretical frameworks such as the ones reviewed earlier in this chapter. For example, within the framework of the DCM, increased utterance length and syntactic complexity may be viewed as demands that exceed the child's capacity to produce such utterances fluently (e.g., Logan & Conture, 1997).

Although, as mentioned above, linguistic complexity has been shown to affect fluency in CWS, investigations of this effect in older speakers who stutter provide different results (e.g., Logan, 2001; Silverman & Bernstein Ratner, 1997). For example, Silverman and Ratner (1997) examined the relationship between syntactic complexity and fluency in adolescents who stutter and adolescents who do not stutter. The participants heard and then repeated utterances which

featured one of three levels of grammatical complexity (i.e., "Wh" questions, right-embedded relative sentences, and center embedded relative sentences). The authors measured the effect of utterance complexity on the accuracy and fluency of sentence imitation by the two groups. The results of the study indicated that increased grammatical complexity affected both speaker groups in a similar manner. Specifically, as the grammatical complexity of the target utterance increased, the percentage of disfluencies and inaccurate responses also increased in both groups. Based on the results of their study, Silverman et al. (1997) concluded that although some syntactic structures continue to be challenging for both adolescents who stutter and adolescents who do not stutter (as observed in the comparable increase in speech disfluencies in both groups in the more syntactically challenging sentences), the effect of syntactic complexity appears to diminish as speakers grow older and their linguistic competency improves.

In a similar investigation, Logan (2001) studied the effect of increased syntactic complexity on speech fluency and timing in younger (i.e., adolescents who stutter) and older PWS as compared across two speaking contexts: (a) a conversational speech task during which the participants generated utterances during a structured conversation, and (b) a sentence reading task that was performed within a reaction time paradigm. In the sentence reading task, the participants read and rehearsed a series of sentences in which the subject noun phrase differed in syntactic complexity. In detail, Logan prepared a base level sentence (e.g., The cake was served at the dinner) and then generated four sentence versions from the base sentence by changing the structure in the "subject constituent" of the sentence. As Logan explained, in sentence version one, a Determiner + Adjective + Adjective + Noun subject constituent was used (e.g., The rich and tasty cake was served at the dinner). In sentence version two, the subject constituent was Determiner + Noun + Prepositional Phrase structure (e.g., The cake from Bill's oven was served

at the dinner). In sentence version three, the subject constituent was Determiner + Noun + Relative Clause (The cake that was fancy was served at the dinner.). Finally, in sentence version four, the subject constituent was Determiner + Noun (e.g., The cake was served at the dinner for the mayor) (For more details, see Logan, 2001, pp. 92-93). Participants were presented with and asked to reproduce the sentences initiating them as promptly as possible following the presentation of a cue (i.e., 1 KHz a pure tone). Consistent with the findings reported by Silverman et al. (1997), Logan reported that speech fluency is comparable between the two groups when producing sentences of varying syntactic complexity. In other words, different levels of syntactic complexity seemed to similarly affect speech fluency in adolescents and adults who stutter. Logan also reported that the means for the different disfluency types examined in the study were similar for the two groups. Based on these finding, Logan concluded that younger PWS seem to control their level of speech fluency and manage sentences of varying grammatical complexity in a manner different from that used by older PWS. Based on those results, Logan suggested, in agreement with Silverman et al., that the factors that underlie stuttering in children might not persist beyond the childhood years.

Methodological Limitations

Although the results from Silverman et al. (1997), and Logan (2001) may appear to argue against a role for syntactic complexity in stuttering in adolescents and adults who stutter, the authors of both studies suggested that using speech elicitation paradigms other than the ones used in their studies (i.e., paradigms other than sentence repetition) might provide information about subtle syntactic effects that exist in the speech production process of PWS. For instance, Logan noted that, in his study, syntactic complexity was defined within a transformational grammar framework. He also suggested that alternate frameworks of complexity, such as those based upon “memory cost” models, might yield different results.

Indeed, a number of alternative paradigms examining the relationship between syntactic complexity and stuttering have provided a different view of this relationship. Such alternative paradigms include using dual-task activities (e.g., Bosshardt, Ballmer, & De Nil, 2002), online grammaticality judgments (e.g., Cuadrado & Weber-Fox, 2003), and speech reaction time (SRT) (e.g., Logan, 2003). Although the three above paradigms are different in terms of their procedural details, the motivation underlying their use seems to be similar in that they all measure the effect of syntactic complexity on speech production in individuals who stutter under conditions of increased cognitive and time loads during online investigations of the speech production process. As suggested by Cuadrado and Webber-Fox (2003), "Additional cognitive loads (e.g., in a dual-task paradigm) have been shown to accentuate differences between NS [non stutterers] and IWS [individuals who stutter] in planning of linguistic units in speech production." (p. 962). The results of such studies have consistently shown that although there is an overlap in the response fluency between PWS and PWNS, increased cognitive loads and interfering "attention-demanding" tasks seem to have a more pronounced effect on the efficiency of retrieval and or encoding of linguistic units during sentence formulation in PWS. For example, results of several studies revealed that under dual tasks (compared to single tasks), PWS require more time for sentence generation and articulation and produce more speech disfluencies than PWNS (Bosshardt, Ballmer, & De Nil, 2002; Caruso, Chodzko-Zajko, Bidinger, & Sommers, 1994). Similarly, results of other studies revealed that under more demanding 'online tasks' (i.e., tasks that are used to measure the effects of a given variable on speech production during ongoing speech processing) versus 'offline tasks' (i.e., tasks that are used to measure the effects of a given variable on speech production after or at the end-point of speech processing), the accuracy of grammaticality judgment in general and syntactic processing in specific in PWS are

most affected by the increased length and syntactic complexity of the target sentence during online tasks as compared to offline tasks (e.g., Cuadrado & Weber-Fox, 2003).

As mentioned above, although syntactic complexity has repeatedly been shown to contribute to breakdowns in fluency in CWS, investigations of this linguistic phenomenon in older PWS seem to provide mixed results. For example, Silverman et al. (1997) and Logan (2001) suggest that the effect of syntactic complexity on fluency might be minimal in older speakers who stutter, while Bosshard (1993) and Cuadrado et al. (2003) suggest that this effect can be observed under certain cognitive demands. The difference between the results offered by the these two study groups could be attributed to several factors among which are the methodological differences. The later group of studies has examined the effect of syntactic complexity on speech formulation and production abilities of PWS when a concurrent or secondary task was used. The results of those studies show a significant effect of linguistic phenomena in PWS. Thus, methodologies that used concurrent tasks seem to add to the cognitive loads during those experiments and that in turn offered a glimpse into the dynamics of this interaction. The following section provides an overview of an alternative online, and thus more demanding methodology- syntactic priming. This methodology has been used for several decades in psycholinguistics research to examine speech formulation processes in both typical speakers and speakers with language delays. As will be shown below, and in agreement with several other researchers, I believe that syntactic priming is a potentially informative methodology for examining syntactic encoding abilities of PWS.

The Syntactic Priming Methodology

Many observations of natural language have reported that speech is “highly repetitious” (e.g., Levelt & Kelter 1982; Bock, 1986). For more than two decades, researchers have successfully shown that the repetitious nature of language can be induced under experimental

conditions by using the priming methodology. The following section will provide an overview of the priming methodology in general, and the syntactic priming methodology in specific. In addition, the following section will provide an overview of the studies that have used the priming methodology to examine the speech formulation processes in speakers who stutter, and particularly, the syntactic processing abilities in this population. A review of phonological and lexical/semantic priming studies will be included for the sake of establishing the feasibility of this methodology in exploring the speech formulation and production processes in PWS.

Syntactic Priming and Speakers with Typical Language Production

It is well documented that, during conversations, speakers tend to repeat grammatical structures that either they or their interlocutors produced earlier in those conversations (for a review, see Bock, 1986; Pickering & Branigan, 1999; Branigan, Pickering, McLean, & Stewart, 2006; Smith & Wheeldon, 2001). As Smith and Wheeldon (2001) explained, repetition in natural language "seems to affect all aspects of the grammatical structure of language such as syntactic frames, formulaic language, individual lexemes or phases, or the lexicon itself"(p.124). Bock (1986) was among the first researchers to show that the repetition of one particular grammatical structure that has been observed in natural language can also be observed in experimental settings. This phenomenon has been termed, variably, structural persistence, syntactic persistence, sentence structure priming or syntactic priming. The term 'syntactic priming' will be used in the present study.

Several hypotheses have been proposed to explain the syntactic priming phenomenon. In her pioneering examination of this phenomenon, Bock explained that her studies were designed to explore 'The syntactic activation hypothesis,' which examines "grammatical patterns in speech result from the application of cognitive realizations of syntactic rules or structure heuristics, perhaps via procedural representations of grammatical structures" (p. 358). Bock

suggested that one consequence of such an application could be a strengthened or elevated level of activation of certain rules or structures, which result in the repetition of a given syntactic structure. To explore this hypothesis, Bock prepared sentences that contained syntactic structures reported in earlier observations to be associated with the persistence (repetitious) effect such as dative sentence structures (e.g., The boy gave the girl a valentine) and passive sentence structures (e.g., The man was stung by a bee).

During the experiment, Bock presented participants with sentences and pictures that were transitive (i.e., the main in those sentences and pictures requires an object as in 'The fireman rescued the baby') and dative (i.e., the main verb in those sentences and pictures requires two objects as in 'The boy(1) gave the girl(2) a valentine'). The participants first heard then repeated sentences such as the transitive sentence 'One of the fans punched the referee.' Next they saw a picture such as that of a tornado destroying a barn and were asked to briefly describe what was happening in that picture in one complete sentence without using any pronouns. The design of the study was such that each of the transitive target pictures could be described by either an active sentence (e.g., A tornado destroyed the barn) or a corresponding passive (e.g., The barn was destroyed by a tornado). Similarly, each of the dative pictures (e.g., a boy giving a valentine card to a girl) could be described either by a prepositional dative sentence (e.g., The boy gave a valentine to the girl) or a double object dative sentence (e.g., The boy gave the girl a valentine).

The results of the study showed that the presentation of a certain syntactic structure (i.e., syntactic prime) prior to a target picture increased the probability of that structure being used to describe the target picture. For example, participants seemed to show an increased use of active structures to describe a picture when the priming sentence they repeated was of an active structure. In a series of follow-up experiments, Bock and colleagues provided evidence that the

generated syntactic structures were not a result of conceptual characteristics of the sentences, and that the priming effect was observed regardless of the content of those priming sentences (Bock, 1986; Bock and Loebell, 1990). Based on the results of those studies, Bock and colleagues concluded that the structural persistence (i.e., priming) effect observed in their experiments was actually a result of activation of syntactic processes, which in their opinion, supported the above mentioned syntactic activation hypothesis. Bock (1986) also suggested that "although processes such as priming may limit the flexibility of syntax in spontaneous real time use of language, perhaps contributing to differences in syntactic diversity between planned and extemporaneous speech," (p.379), such a process could also have "an adaptive function." Bock further explained that the expression of unplanned messages during speech "can create problems that lead to hesitations, errors, and other disruptions (p.379). As suggested by Bock, reusing structures that were available in an earlier sentence (within a context similar to the one used in the study) could contribute to fluency since "it employs procedures that are already activated" and this in turn may ease the demands of generating the target message.

These conclusions were tested more recently in a series of six experiments conducted by Smith and Wheeldon (2001). The experiments examined the effect of syntactic priming on speech initiation times (SIT), among other variables, in typical adult speakers. The authors suggested that if syntactic persistence results from reusing already activated procedures, syntactic priming may positively affect temporal factors in speech production by reducing the time speakers need to initiate utterances. The first experiment reported by Smith et al. (2001) was designed to investigate the hypothesis that syntactic persistence reduces the time dedicated to syntactic planning (as observed in reduced speech onset latencies or a shorter SIT). The material of the study consisted of a variety of moving pictures. In the 'syntactically related'

condition and as described by Smith et al. " the prime and target trial sentences were matched both in terms of the grammatical role of the phrases they assigned nouns to (i.e., a subject phrase) and in terms of the complexity of the internal structure of the phrase they assigned nouns to (i.e., a conjoined noun phrase."(p.130). An example of a target phrase used in the study is 'The spoon and the car move up,' and a corresponding syntactically related sentence is 'The eye and the fish move apart.' In the "syntactically unrelated" condition, Smith and Wheeldon (2001) explained that "the prime trials matched the target trials in terms of the grammatical role of the phrases they assigned nouns to but not in terms of the complexity of the internal structure of the phrase they assigned nouns to (i.e., a simple noun phrase rather than a conjoined noun phrase). (p.130). An example of a syntactically unrelated priming sentence used in the study is 'The eye moves up and the fish moves down.'

During the experiment, participants described black and white line drawings of objects moving in different directions on a computer screen. Prior to the experiment, the participants were instructed to describe the picture movements from left to right using specific sentence types. Speech production latencies were measured to determine whether there were significant differences in speech latencies between the syntactically related and syntactically unrelated conditions. The results of the study revealed that target sentences that were preceded by syntactically related primes were produced at significantly shorter (55 ms) speech latency than target sentences that were preceded by unrelated syntactic primes. Based on the results of the study, Smith and Wheeldon concluded that "Clearly, such a result provides the first evidence compatible with the hypothesis that syntactic persistence benefits speakers by reducing the processing costs incurred by syntactic structure generation" (p.138).

As observed in both Bock (1986) and Smith and Wheeldon (2001) experiments, syntactic priming seems to be a reliable methodology for examining sentence structure generation and production processes in typical speakers. In addition, the presentation of syntactically related primes prior to targets seems to facilitate sentence generation processes as measured by the reduced speech latencies under the related syntactic prime condition. In an above-presented explanation of how the syntactic effect works, Bock had suggested that although syntactic persistence might "limit the flexibility of syntax in spontaneous speech" it might also have "an adaptive function" in the sense that the expression of unplanned messages during speech "can create problems that lead to hesitations, errors, and other disruptions" (p.379). Both Bock (1986) and Smith et al. (2001) also seem to agree that message generation under some conditions might impose additional cognitive loads that may affect the timing and fluency of the uttered sentence.

Since syntactic priming has been shown to enhance fluency during real time tasks in typical speakers, numerous studies have examined this phenomenon and whether similar results can be observed with atypical speakers. The following section provides results of such studies.

Syntactic Priming and Speakers with Atypical Language Production

In addition to its use with speakers exhibiting typical language abilities, the priming methodology has also been used to examine syntactic processing abilities in speakers with atypical language production. For example, the syntactic priming paradigm has been used to examine difficulties in grammatical processing in aphasic patients (e.g., Hartsuiker & Kolk, 1998; de Roo, Kolk, & Hofstede, 2003), patients diagnosed with dyslexia (Faust, Silber, & Kaniel, 2001), and patients diagnosed with schizophrenia (e.g., Besche, Passerieux, Segui, Sarfati, Laurent, & Hardy-Bayle, 1997).

For example, Hartsuiker et al.'s 1998) study revealed that patients with Broca's aphasia showed stronger syntactic priming effects than the typical control speakers, and that although the

speech of such patients is usually characterized by a reduced complexity of syntactic structure, these patients produced relatively complex sentence structures (such as passives) when those structures were primed. Hartsuiker et al. (1998) explained that some hypotheses suggest that patients with Broca's aphasia might suffer from reduction in their capacity for generating grammatical structures, especially complex ones, which may result from either slowness or "reduced maintenance"/"fast decay" in the generation of grammatical information. Within this view, and based on the results of their study, Hartsuiker et al. provided a number of conclusions among which was that limitations in computational resources in patients with Broca's aphasia can be overcome by using facilitatory processes such as syntactic priming.

Besche et al. (1997) used syntactic priming to examine the hypothesis that some types of schizophrenic disorders might have the "disorganization of cognitive" activities as an underlying cause and particularly disorganization of semantic and syntactic relations during the processing of lexical information. The results of the study revealed that the performance of the schizophrenic patients pertaining to the processing of syntactic information was identical to that of the typical controls. In addition, results revealed that both groups showed a significant syntactic priming effect as observed in the form of reduced SIT during a decision making task.

As can be concluded from the two examples above, syntactic priming is a methodology that can be helpful in examining syntactic formulation and production abilities in atypical populations as well as typical speakers. The following section provides an overview of a number of studies that have used the priming methodology to examine speech processing abilities of PWS.

The Priming Methodology and People who Stutter

As mentioned above, both empirical evidence and theoretical explanations suggest that stuttering might result from difficulties in generating or encoding syntactic units. In addition, a

number of hypotheses suggest that speakers who stutter may exhibit limited capacities to generate fluent speech under conditions of increased linguistic or cognitive demands (DCM; e.g., Starkweather, 1987). If this is the case, then the facilitatory effect of syntactic priming that has been shown in several clinical populations who exhibit limitations in speech generation capacities (e.g., patients with Broca's aphasia) may also enhance speech fluency in PWS.

Although the priming methodology has been used in studies of speech production with both typical and clinical populations as shown in the previous section, its application to stuttering is still in its infancy. Most of the studies that have used priming to examine speech formulation in PWS have used priming to examine the time course of phonological and lexical/semantic encoding in children and PWS (e.g., Burger & Wijnen, 1999; Hartfield & Conture, 2006; Melnick, Conture, & Ohde, 2003; Pellowski & Conture, 2005; Wijnen & Boers, 1994). To my knowledge, only one study thus far used priming to examine the syntactic processing abilities of speakers who stutter (Anderson & Conture, 2004). Although as mentioned syntactic priming is the scope of the present study only covers syntactic priming, I believe that is it worth presenting studies that used other priming methodologies such as phonological and lexical/semantic priming in persons who stutter. Presenting such studies will help establish that the priming methodology can be reliably used to examine speech formulation and production abilities of this population. The following section first provides an overview of studies that have used the priming methodology with PWS and the main results of those studies, and then provides the rationale for using syntactic priming to examine syntactic processing abilities of PWS.

Phonological Priming and PWS

Wijnen and Boers (1994) were the first researchers to use the priming methodology to examine phonologic encoding abilities of PWS. The study was designed to test the hypothesis that stuttering results from problems in phonological encoding and particularly the encoding of

syllable rime ("the syllable constituent capturing the vowel and any final consonants" (p.5)). Wijnen and Boers explained that "It is assumed that priming increases the activation level of the involved phonological segment(s) so that incorporation [of those segments] in the articulatory plan is facilitated." (p.6). The participants in the study were nine adults who stutter and nine adults who do not stutter (all native speakers of Dutch). Two phonological priming conditions were used: priming the initial consonant (C-Block), and priming the initial consonant and subsequent vowel (CV-Block). A cue word was visually presented and the participants had to utter a response word (out of a set of five words) that was assigned to the cue word and which the participants learned prior to the online experiment. There were five blocks of five-word sets that were either homogeneous (all words shared the same consonant or shared the same consonant and vowel) or heterogeneous (words were a combination from each of the homogeneous sets). For example, in the homogeneous condition of a C-Block, the cue word was "vork" the corresponding response words were "Lepel", "Lila", "loeder", "larie", and "Luir". Speech reaction time was measured in each of the priming conditions. The results of the study indicated that SRT in the C-Block was significantly faster during the homogeneous condition (606 ms) than it was in the heterogeneous condition (639 ms), indicating a larger priming effect during the former condition (although, as the authors reported in a follow up study presented below, this effect was only observed in only four out of the nine study participants). The authors also reported that in most participants who stutter, reduction of SRT occurred only when the words shared both the consonant and vowel. Based on the results of the study, Wijnen and Boers concluded that there is a difference in phonological encoding abilities between PWS and PWNS, and that the results indicate that the encoding of stressed vowel at the non-initial parts of the syllable might be delayed PWS.

In a follow up study, Burger and Wijnen (1999) replicated the Boers et al. study using a larger group of participants and new stimulus words. Similar to Boers et al., the results of the follow up study indicated that (a) the overall SRT for PWS was slower than that for PWNS, (b) SRTs were faster in the homogeneous condition compared to the heterogeneous condition, and (c) the priming effect was more prominent when the priming word and the target shared the initial CV than when they only shared the initial C. However, Burger et al. also reported that they failed to replicate the interaction effect between group, prime type, and condition reported in the Boers et al. study. In other words, the authors reported that both groups benefited from priming similarly and showed a similar and larger effect of priming in the CV condition compared to the C condition.

In a more recent study, Melnick and Conture (2003) also examined the effect of priming on phonological encoding in general and speech reaction time in particular in preschool children who do and do not stutter. The authors hypothesized that "if CWS do, in fact have an impaired ability to quickly phonologically encode as the CRH suggests, then their ability to benefit from phonological priming may not be as apparent or as great as that of CWNS." (p. 1438). The study included 18 children who stutter (CWS) and 18 children who do not stutter (CWNS) (3-5 year old). Unlike Wijnen and Boers's (1994) study design, Melnick and Conture's (2003) priming condition had three levels: No prime, related phonological prime, and non related phonological prime. In the no prime condition, the children saw pictures of common objects and were asked to name the objects as fast as they could. In the related priming condition, the children saw and described the same objects presented in the first condition; however, 500 ms prior to picture presentation, the children heard either a related or unrelated "auditory stimulus". The auditory stimulus either shared (related prime) or did not share (unrelated prime) the first CV or CCV of

the picture (authors did not provide examples). Participants were instructed to name pictures as fast as they could and SRT was recorded during the trials. Similar to the results reported by Wijnen and Boers (1994), the results revealed that children in both groups exhibited faster SRT during the related versus unrelated prime conditions. The results also indicated that the older children in both groups exhibited an overall faster SRT than the younger children, and that the older children in both groups exhibited faster SRT during the related priming condition than the two other conditions. Post hoc analyses revealed that there was a difference between the two groups in the relationship between children's scores on tests of articulatory mastery and their reaction time scores. Specifically, the authors reported that the higher the scores of the children who do not stutter on articulatory mastery tests, the faster their reaction times were during picture naming. This relationship was not observed in CWS. Based on these results, Melnick and Conture concluded that "preschool children who stutter, as a group, may have somewhat less well developed articulatory systems than preschool children who do not stutter." (p.1428). Most importantly, the authors suggested that phonological priming methodology could help in examining the "speech-language" planning and production of young (i.e., 3-5) year-old speakers.

Lexical/Semantic Priming and PWS

Priming methodology has also been recently used to examine lexical/semantic-encoding abilities of CWS (Hartfield & Conture, 2006; Pellowski & Conture, 2005). Pellowski and Conture examined the effect of priming on SRT in both CWS and CWNS. The participants in the study were 23 CWS and 23 CWNS stutter ranging in age from 3;0 (years;months) to 5; 11. The study included three priming conditions: no prime (i.e., no auditory stimulus was presented prior to the target picture), a related prime condition (i.e., a semantically related prime was presented 700 ms prior to the target picture; e.g., auditory prime "boat" and target picture "car"), and a non related prime condition (i.e., a semantically unrelated prime was presented 700 ms prior to the

target picture; e.g., auditory prime “fork” and target picture “car”). The authors reported two findings pertaining to the priming effect: (a) SRT was significantly slower in CWS compared to CWNS across the three priming conditions, and (b) When comparing no prime condition to semantically related condition, responses of CWS were significantly slower than the responses of CWNS. Based on these results, Pellowski and Conture concluded that CWS may exhibit difficulties with lexical encoding which in turn may contribute to the speech disfluencies produced by those children.

Similar to Pellowski et al. (2005), Hartfield and Conture (2006) examined the effect of conceptual and perceptual properties of words on lexical retrieval in CWS and CWNS. The participants in the study were 15 3-5 year old CWS and a matched group of CWNS. Participants in the study named objects presented under four lexical priming conditions: (a) a neutral prime-pure tone, (b) a prime word physically related to the target word (e.g., prime word “tomato” and target word “apple”), (c) a prime word functionally related to the target word (e.g., prime word “bite” and target word “apple”), and (d) a prime word categorically related to the prime word (e.g., prime word “lemon” and target word “apple”). The authors reported the three following main findings: (a) Similar to the findings of Pellowski et al., CWS were significantly slower at initiating fluent accurate responses than CWNS, (b) Functionally related prime and target resulted in faster responses from CWS (but not CWNS) than physically related prime and target, and (c) there were no significant differences between CWS and CWNS in error production. Based on the results of the study, Hartfield and Conture suggested that the difference between the two groups in SRT during picture naming could result from “subtle differences in various aspects of speech-language planning” (p.320). The authors further suggested that the source of

these differences might be found in "(1) the linguistic plan, (2) the motor program, and/or (3) the transfer of information between linguistic plan and motor program" (p. 320).

Syntactic Priming and PWS

To my knowledge, Anderson and Conture (2004) are the only researchers who used the priming paradigm to examine syntactic processing abilities in persons who stutter. As Anderson et al. (2004) explained, their study was motivated by consistent earlier reports of relationships between utterance length, syntactic complexity, and fluency in CWS. The authors explained that findings of such relationships suggest that "young CWS may experience some degree of difficulty quickly and/or efficiently formulating morphosyntactic structures" (p.553). The authors suggested that using the syntactic priming methodology "may help us better understand selective aspects of the temporal component of linguistic processing in young CWS, particularly those associated with syntactic processing" (p. 555).

In detail, Anderson and Conture used the syntactic priming methodology to examine syntactic processing in CWS. The participants in the study were 16 CWS and 16 CWNS stutter between the ages of 3;3 and 5;5. The authors used a syntactic priming task that they described as "an age-appropriate version of the syntactic priming paradigm [which was used by Bock and colleagues in several psycholinguistic studies]" (p.552). The authors explained that latencies of responses (i.e., SRT) for the participating children were measured during a syntactic priming task that consisted of two conditions-a no prime condition and a syntactic prime condition. An unrelated syntactic prime condition was not used in the study because a pilot study showed that when such a condition was used with younger children, the unrelated primes seemed to affect the probability of the children later producing the target syntactic structures and thus resulting in the children not producing enough samples of the target sentence structure.

The experimental pictures used in the study could be described by using simple, active, affirmative, declarative (SAAD) sentences, such as 'The girl is petting the cat.' The other/filler pictures could be described using other types of sentences such as negatives. In the no-prime condition, children were presented with pictures and were instructed to describe each picture as quickly as possible. Each picture was presented for 3000 ms, and children's responses were recorded so that SRT could be assessed for each of the responses. During the no-prime condition, children saw the same pictures used in the syntactic prime condition , however, 2000 ms prior to the onset of picture presentation, a priming sentence that exhibited a syntactic structure similar to that of the target sentences was auditorily presented.

Consistent with studies of typical speakers (e.g., Smith & Wheeldon, 2001), the results of the study revealed that SRT for both groups was shorter during the related syntactic prime condition compared to the no-prime condition (in CWS: shorter by approximately 212 ms, and in CWNS: shorter by approximately 51 ms). Results further revealed that there were significant differences between the two groups in the priming effect. Specifically, CWS were significantly faster by approximately 212 ms in the syntactic-priming condition than in the no-prime condition compared to CWNS (51 ms) who did not show a significant difference in SRT between the two conditions. Based on these results, and among other conclusions, Anderson and Conture concluded that CWS seemed to benefit more from syntactic priming than CWNS.

Summary

In summary, both theoretical and empirical evidence suggest that stuttering might result from difficulties in speech formulation processes prior to speech production. In addition, evidence from numerous studies suggests that increased linguistic loads during the speech production tasks seem to affect the temporal and fluency characteristics in PWS differently than in PWNS. Experimental designs that incorporate methodologies such as priming may offer a

better understanding of how increased linguistic demands affect speech formulation and production in PWS. Methodologies such as the syntactic priming methodology and the material used by Bock and colleagues during the study tasks could be specifically helpful in such an investigation because this material has the following appealing features:

- The material used by Bock and colleagues in the syntactic priming studies has been used for over two decades and has provided reliable results about syntactic processing in typical adult speakers. This in turn is expected to provide us with a basis for comparing the results we obtain in the present study with both PWS and PWNS to the results of earlier studies that used this methodology.

- A series of follow-up studies by Bock and colleagues clearly established that the carefully prepared material which was used in the syntactic priming studies insured that the syntactic priming effect observed in studies using that material is independent of lexical (Bock, 1986) and thematic/semantic effects (Bock & Leobell, 1990).

- A more recent study with CWS (Anderson and Conture, 2004) showed that syntactic priming is a feasible procedure for studying speech-language planning and production in PWS.

- The sentences used by Bock and colleagues in the syntactic priming studies include sentences that cover a variety of syntactic structures (e.g., transitive, dative, two-clause embedded and conjoined) and syntactic complexities (i.e., transitive-low, dative-intermediate, and two-clause- high syntactic complexity) and thus can be used to examine the effect of different sentence types on speech production processes in both PWS and PWNS (a detailed review of those sentence structures is presented in Chapter II).

Thus, it seems reasonable to suggest that using the syntactic priming methodology, particularly the materials used by Bock and colleagues in their syntactic priming studies, could provide important information and initial insights into the temporal and syntactic production abilities of persons who stutter and in turn yield useful information about the factors that are associated with disfluent speech.

Research Questions

The central question for this study is as follows: Is there a significant difference between adults who stutter and adults who do not stutter in syntactic formulation and production under conditions of increased linguistic demands? The four following questions are related to this

broad issue and are specifically related to the effect of syntactic structure and syntactic priming on speech fluency and speech reaction time in responses produced by PWS and PWNS.

Question One

Does syntactic structure affect speech fluency of persons who stutter and persons who do not stutter? If so, is speech fluency of persons who stutter affected differently by syntactic structure than that of persons who do not stutter?

Question Two

Does syntactic structure affect speech reaction time in persons who stutter and persons who do not stutter? If so, are speech reaction times of persons who stutter affected differently by syntactic structure than those of persons who do not stutter?

Question Three

Does syntactic priming affect speech fluency in persons who stutter and persons who do not stutter? If so, is the percentage of fluent responses produced by persons who stutter affected differently by syntactic priming than that of persons who do not stutter?

Question Four

Does syntactic priming affect speech reaction time in persons who stutter and persons who do not stutter? If so, are speech reaction times of persons who stutter affected differently by syntactic priming than those of persons who do not stutter?

CHAPTER 2
METHODS

Participants

15 PWS and 15 PWNS participated in the study. The mean age for the participants who do not stutter was 32.2 years (S.D. = 12.76 years; range 21 - 59) and the mean age for the participants who stutter was 32.4 years (S.D. = 14.05 years; range 19 – 59). Persons in the two groups were matched for years in school (+/- 3 years), age (+/- 2 years) and gender (10 male, and 4 female participants in each group). Overall, 14 out of the resulting participant pairs were also matched for age and years in school. One pair was not matched for years in school nor age (PWS: 12 years in school, 52 years old; PWNS: 16 years in school, 24 years old). Several mechanisms were used to recruit participants. These included contacting patients on the waiting list for diagnostic evaluations at the University of Florida Speech and Hearing Clinic and at several speech and hearing clinics in the State of Florida, posting signs on the University of Florida campus, and by making announcements in university classes, and posting advertisements in local and college newspapers.

Prior to participating in the study, participants completed several formal and informal tasks that were used to determine their eligibility for the study. These tasks are explained in detail below. Participant characteristics are presented and summarized in Table 1.

Inclusion and Exclusion Criteria

Participant inclusion and exclusion criteria were as follows:

General inclusion criteria: To be included in the study, participants had to:

- be native speakers of American English.
- have a negative history of any medical, neurological, or emotional conditions that might influence their performance during the study.

- have no active speech or language impairments other than stuttering and have no past history of language-related special services at any point during their academic careers.

There were 16 participants who stutter and 22 participants who do not stutter who initially participated in the study. From this initial group, 3 PWS and 8 PWNS were excluded from the analysis for the following reasons:

- One participant who stutters completed the protocol for the study; however, the participant's data were excluded from final analysis because he failed to meet the inclusion criteria described above (i.e., had a positive history of neurological problems).
- Although 22 participants who do not stutter completed the study protocol, data for only 15 participants in this group was used in the analyses. These participants were selected to insure a good age, education, and gender match with the participants who do not stutter. The excluded participants either did not match the PWS in age or in education. In addition, several of the participants in the PWNS group had an academic background in linguistics and data from meetings with those participants were not included from the analyses. This was done to eliminate any bias in the results based on those participants' prior knowledge or exposure to procedures and data similar to the ones used in the present study.

Material

Measurements of speech reaction times, speech fluency, and sentence structure were made from audio and video recordings, which were collected during a syntactic priming task that lasted approximately 50 minutes. Details about the study material (i.e., pre-study tasks and main task), data preparation, and study procedures are described immediately below and are also summarized in Table 1.1.

Pre-Study Material Used with all Participants

Background survey (Appendix A)

All participants finished a survey aimed at getting background information about their speech and language abilities. Information included the general speech and communication skills and educational background. There were two forms for this survey: one used with the PWS and the other with the control group (i.e., PWNS). The survey asked participants about any speech, language, vision, or hearing problems they might exhibit. The survey also asked the participants

about their education level, type of school they went to (i.e., two year vs. four-year College) in addition to the highest educational degree earned by the participant.

WAIS vocabulary

The Vocabulary subset of the WAIS test is usually used as a general measure of intelligence and of verbal comprehension. It can also provide information about the participant's education and life experiences (see Zimmerman and Woo-Sam, 1973 for a detailed description of this test). The test consists of 35 words, which the participant is asked to define. The words on the test are listed in order of difficulty and have equal numbers of nouns and verbs, plus several adjectives and one adverb. As explained by Zimmerman and Woo-Sam (1973), "Vocabulary indicates sensitivity to new information and ideas and the ability to store and associatively regroup these as the occasion demands."(p. 108).

The mean score for the PWNS was 62.79 out of 70 and the mean score for the PWS was 54 out of 70. The results of the t tests for the WAIS vocabulary test indicated a significance difference between the two groups (t (26) = 2.538, two-tailed p = 0.017).

Digits forward and digits backward

The tests measure immediate auditory recall, attention, concentration, and the ability of the participant not to be affected by distracters. In general, the point of interest in the tests is to identify whether the participant's responses on the test show any discrepancy between digit forward and digit backward recall and if that is the case, the direction of this discrepancy (i.e., in favor of digit forward or digit backward).

The mean score on the Digits Forward test for the group was 10.93 out of 14 and the mean score for the PWS was 9.50 out of 14. The results of the t tests indicated no significant difference between the two study groups on the digits forward test (t (26) = 1.286, two-tailed p = 0.210).

The mean score on the Digits Backward test for the PWNS was 9.07out of 14 and the mean score for the PWS was 7.29 out of 14. The results of the t tests indicated no significant difference between the two study groups (t (26) = 1.632, two-tailed p = 0.115).

Digit ordering

This test is used to assess linguistic working memory and/or language processing skills (see Maryellen C. MacDonald, Amit Almor, Victor W. Henderson, Daniel Kempler, and Elaine S. Andersen, 2001 for details).

The mean score for the PWNS group was 20.43 out of 24 and the mean score for the PWS group was 17.21 out of 24. The results of the t tests indicted a significant difference between the two study groups on the digit ordering test (t (26) = 2.5380, two-tailed p =.010).

Pre-Study Material Used with PWS

Stuttering severity level task (Appendix A)

Two speech samples, each of which was approximately 300 syllables long, were elicited from each of the participants in the experimental group. This task was used to provide additional information about the speakers' overall level of speech fluency. To elicit the speech samples, each of the PWS was asked to talk for 3 minutes about the plot of a movie they had seen recently, and then for another three minutes about a pleasant experience they had. The resulting speech samples were audio and video recorded and later analyzed for (a) types of disfluency produced (i.e., 'repetitions and prolongations' such as the prolongation of sounds, or the repetition of sounds or parts of words, the repetition of monosyllabic words, multi-syllabic words, or phrases, or 'other' disfluencies such as revisions of words or phrases and interjections) (b) percentage of syllables stuttered in a speech sample of 100 syllables.

Self-rating scale (Appendix A)

In addition to the above pre-study tasks, each of the participants who stutter finished a self rating scale intended to get general information about each participant's stuttering severity during everyday situations.

Preparation and Description of the Material Used in Syntactic Priming Task

The sentences and pictures used in the present study were originally developed and used in syntactic priming studies conducted by Bock and colleagues and later adapted and used by Dr. Lori Altmann at the Language over the Lifespan Laboratory at the University of Florida (Bock, 1986, 1989; Bock & Griffin, 2000; Bock, Leobell, & Morey, 1992). The material consisted of priming sentences and associated picture representations, plus a variety of filler sentences and their associated picture representations. The remainder of this section describes those sentences and their associated pictures in detail. It is worth mentioning that although I provide a detailed description of the study material below, the material used was generously shared by Dr. Lori Altmann at the University of Florida who used the same sentences and pictures to elicit responses in studies using methodology similar to the one used in the present study.

The study material consisted of 54 sets of priming sentences, which were paired with 54 pictures of events. A given priming sentence set was classified as transitive, dative or two-clause based on (a) the main verb type in each sentence, (b) the syntactic complexity of each sentence as described below in detail (See Appendix B for a list of all the priming sentence sets). The following section provides a detailed description of each of these three sentence types.

Transitive priming sentences and pictures

There were eighteen sets of transitive priming sentences each of which included an active sentence, a corresponding full passive (a 'by' passive) sentence, and a locative sentence. The locative sentences were used in Bock and colleagues' studies as a control condition to prime the

passive sentences since the two sentence types had a similar phrase structure (see below). The structure of the active sentences in the transitive priming set was as follows: a subject noun phrase, followed by a transitive verb and a direct-object noun phrase as in Example (1):

(1) The construction worker drove the bulldozer.

The structure of the corresponding passive sentence in the transitive priming set was as follows: subject noun phrase, followed by a full passive verb, and the preposition *by* followed by a prepositional noun phrase as in Example (2)

(2) The bulldozer was driven by the construction worker

The structure of the locative sentence in the transitive priming set was as follows: a subject noun phrase, followed by a verb in the present participle form, and the preposition *by* followed by a prepositional noun phrase as in Example (3):

(3) The construction worker was digging by the bulldozer.

Each of the transitive priming sets was matched with one target picture intended to elicit transitive verbs (active and passive). Each of the transitive verb pictures depicted an action involving an agent and an object undergoing the action (i.e., each transitive picture included two actors in the pictured event). The actions depicted in the pictures included driving, destroying, striking, chasing, kicking, towing, stinging, hitting, kissing, pushing, and squirting (e.g., lightning striking a church, and a wrecking ball destroying a building). The action in each of the transitive pictures could be described using either an active transitive or a passive transitive sentence structure. To illustrate, one of the transitive sets included the following three sentences: Active: ‘The lumberjack struck the giant redwood tree’; Passive: ‘The lumberjack was struck by the giant redwood tree’; Locative: ‘The lumberjack was eating by the giant redwood tree.’ The

picture matched with this set was of a fireman rescuing a baby from fire (See Appendix B for a full list of the transitive sentence sets and target picture that was matched with each set).

Dative priming sentences and pictures

There were eighteen sets of dative verb sentences each of which included a prepositional dative sentence, a corresponding double-object dative sentence, and an object complement sentence. The object complement sentences were used in Bock and colleagues' studies as a control condition to prime the double-object sentences since the two sentence types have a similar phrase structure as described below. The structure of the prepositional dative sentence was as follows: a subject noun phrase, followed by a dative verb, which was followed by a direct-object noun phrase, and a prepositional noun phrase beginning with *to*, as in Example (4):

(4) The children sang a song to their babysitter.

The structure of the corresponding double-object sentence in the dative priming set was of a subject noun phrase, followed by a dative verb, which was followed by a direct-object noun phrase, and an indirect-object noun phrase, as in Example (5):

(5) The choir sang the wedding guests a new hymn.

The structure of the control object complement sentence in the dative priming set was as follows: a subject noun phrase, followed by a dative verb, which was followed by a direct-object noun phrase, and an object complement as in Example (6):

(6) The choir considered the new hymn their favorite song.

Each of the sentences in the dative priming sets was matched with a target picture intended to elicit dative verbs. Each of the dative verb pictures depicted an action involving an agent, an object undergoing the action, and a recipient of the action (i.e., each dative picture included three actors in the pictured event). The actions depicted in the pictures included giving, showing, throwing, passing, reading, serving, and handing (e.g., a librarian giving a book to a boy, and a

waitress serving drinks to a man). Each of the dative priming pictures could be described using either a double-object dative or a prepositional-dative sentence structure. To illustrate, one of the dative sets included the three following sentences: prepositional dative 'The diplomat took the secret documents to the president', double-object dative 'The diplomat took the president the secret documents,' and object complement 'The diplomat made delivering the secret documents his primary mission.' The picture matched with this set was of a girl and a boy showing a picture to a teacher (See Appendix B for a full list of the dative sentence sets and target picture that was matched with each set).

Two-clause priming sentences and pictures

There were eighteen sets of two-clause sentences each of which included a conjoined sentence (i.e., two independent clauses joined using the coordinating conjunction 'and', or the subordinating conjunction 'because'), a center-embedded (subject-subject) relative clause, and a right-embedded (object-object) relative clause (i.e., one independent clause and one center or right embedded relative clause) as in Examples (7), (8), (9) respectively:

(7) The duck is kicking the girl and the girl is kicking the boy.

(8) The girl that is kicked by the duck is kicking the boy.

(9) The duck is kicking the girl that is kicking the boy.

Each sentence in the two-clause priming sentence sets was coupled with a picture that was intended to elicit sentences that can be described using either a conjoined clause, a center-embedded clause, or a right-embedded clause. To illustrate, one of the two-clause sets included the three following sentences: conjoined 'The girl smelled the flower and it reminded her of her grandmother,' center-embedded 'The girl that smelled the flower was very pretty,' and right-embedded 'The girl smelled the flower that was very pretty.' The picture matched with this set

was of a man pulling a woman who was pulling a dog (See Appendix B for a full list of the dative sentence sets and target picture that was matched with each set).

Filler sentences and pictures

In addition to the priming sentences and target pictures described above, there were 127 filler sentences and pictures (See Appendix B for a list of the filler sentences). The filler pictures were similar in style and preparation to the experimental pictures but depicted actions that are commonly described with sentence forms different from those used in the priming sentences. Forms used in the filler sentences included reflexives, and predicate adjective sentences as in Examples (10) and (11) respectively:

(10) The surgeon cut himself with a scalpel

(11) The books were expensive.

Using the above described sentences and pictures, three lists were developed and used in the study. Each of the lists contained 252 priming trials that consisted of random presentations of a priming sentence, priming picture, filler sentence, or filler picture. Each of the priming sentences was immediately followed by a priming picture. Thus a typical sequence of stimuli in a priming trial was: filler sentence, filler picture, priming sentence, priming picture. The filler sentences were randomly interspersed within each list and could either have the sequence of one, two, or three consecutive filler sentences followed by one, two, or three filler pictures. There were ten filler sentences between each two priming sentences.

The transitive, dative, conjoined, and embedded priming sentence sets alternated in each list so that an equal number of each sentence structure occurred in each list (6 sentences each of active transitive, passive transitive, locative, double-object dative, prepositional dative, object compliment, conjoined, center-embedded, and right-embedded, resulting in 9 sentence types x 6 instances of each type, which equaled a total of 54 priming sentences and 54 corresponding

target pictures in each study list). The different sentence structures alternated in the lists in a way that ensured participants did not encounter two priming sentences or two target pictures of the same type in successive priming trials. Each list included only one sentence type from each set. For example, list A included the transitive active sentence 'The lumberjack struck the giant redwood tree,' list B included the corresponding passive sentence from that set 'The lumberjack was struck by the giant redwood tree' and list C included the locative sentence of that set 'The lumberjack was sitting by the giant redwood tree.' The same procedure was followed for the distribution of all other sentence sets among the three study lists. The order of the priming trials was the same in the three lists.

Following the data collection session, each participant's audio and video-recorded speech sample was transcribed orthographically and then coded to get specific information for each sentence. Information about sentence type, speech reaction time, and fluency for sentences produced by each of the participants was determined as described below under ***Data Analysis.***

Apparatus

A digital voice recorder (Olympus WS-100) was used to record responses during the pre and main study tasks. During the experiment, the stimuli were presented on a laptop computer (Dell Inspiron 15150) and the speech productions were recorded using a lightweight headset microphone (Optimus 33-3012) that was approximately two inches from the speaker's mouth. The study material was presented using Direct-RT (DirectRT 2006 2.16) a graphical experiment generator which is capable of managing and analyzing data during time controlled experiments such as the one used in the present investigation. Direct-RT also recorded in milliseconds each participant's SRT for picture description during the study task.

Procedures

Data Collection

Each of the percipients was seen individually for one session divided into two parts. Upon successful completion of eligibility testing in the first part of the session (described above under Material), participants finished the second part of the session (i.e., the syntactic priming task) during which SRT and fluency data collection took place. The first part of the session took 20 to 25 minutes to complete, and the second part took 45 to 60 minutes to complete. It is worth mentioning that the participants finished a second task (i.e., sentence generation task); however, data and results for responses during that task are not reported in this paper. The following is a detailed description of the procedures followed during the syntactic priming task.

I described the task to the participants and told them that the first 9 items were practice material. The participant saw either a picture on the computer screen or the sentence, "Listen and Repeat." When they saw a picture, they were instructed to 'make up' a one-sentence description of the event pictured and say it aloud as soon as possible after the picture appeared. They were also instructed not to use pronouns in their picture. This instruction was added to 'motivate' the participants to produce the appropriate number of noun phrases representing the main actors in the depicted events such as 'The bear is kicking the girl and the girl is kicking the boy' instead of a partial description such as 'They are kicking each other' when a pronoun is used in that response. When the participants saw the sentence "Listen and Repeat," I read a sentence and the participants were instructed to repeat the sentence I just read. The participants were told that the experimenter could read the sentence again if it was not clear the first time.

If the participant responded successfully to the first 9 items on the list, the experimental sentences and pictures were presented. In instances were participants' response to a trial item was not accurate or when the participant seemed confused about the nature of the expected

response, I explained the error made by the participant on that trial and asked the participant to repeat his/her response to that trial following the correct instructions. After finishing the first 9 items in the task, the main task items were presented individually on the computer screen.

For each trial, the instruction "Listen and Repeat" and the picture remained on the screen until the participant repeated the sentence or finished the description of the pictured event. Immediately after each response, the participants were asked if they've heard the sentences or seen the pictures before within the course of the experiment by answering the questions "Have you heard this sentence before?" that immediately followed their sentence repetition and the question "Have you seen this picture before?" which immediately followed their picture description. Participants answered the question by responding "yes" or "no." The questions were used as part of a "recognition memory test" following Bock (1986) procedures to "minimize subjects' attention to their speech and its structural features (p. 360). The question remained on the screen until the participant responded to that question. I then pushed a mouse button which in turn triggered the software program to move to the next trial.

The participants were told when the practice items were presented that the task is rather long (on average took participants about 50 minutes to finish) and that they would be offered several opportunities to rest, if necessary, during the task. Participants were also told that they could ask for a break at any time during the task.

Data Preparation for Analyses

To summarize the method used to generate the data for this study, I transcribed verbatim all sentences produced by the participants. Each sentence was then coded as a target sentence or filler sentence. All filler sentences were excluded from further analyses. The remaining sentences were further coded for general descriptive characteristics (i.e., number of syllables and words in each sentence), grammaticality (i.e., whether the sentence was grammatical or not), sentence

type (whether the sentence was transitive, dative, two-clause, or other), and for fluency measures (i.e., whether the sentence (a) was all fluent, (b) contained a speech disfluency in any part of the sentence, (c) contained a speech disfluency in the first noun phrase in the sentence , (d) contained a speech disfluency in the first word of the first noun phrase in the sentence; as well as the number of disfluencies in each sentence, and the type of disfluencies in each sentence).

The transcripts were used to determine response fluency (i.e., fluent or disfluent; 'repetitions and prolongations,' or 'other' types of disfluencies, and the location of disfluency within an utterance) and response structure (i.e., Transitive: active, passive; Dative: prepositional dative, double-object dative; Two-clause: conjoined, embedded). The following are the details of data preparation for analysis.

Data excluded from the final analyses

Three main data analyses were of interest in the present study: fluency analysis, sentence type analysis, and SRT analysis. For each analysis, several responses were excluded from the final analyses based on criteria following either procedures used in other studies (e.g., Bock et al. 1986, Logan, 2003). Out of 1620 possible responses for the two groups (i.e., 54 responses x 30 participants), 1617 sentences were actually produced and a total of 328 (20.28%) sentences were excluded from the final analyses based on the application of a number of exclusion criteria which are described below.

The first of the sentence exclusion criteria concerned elicitation and response problems (i.e., problematic responses). A 'problematic' response was defined as one that was associated with (a) an unrelated vocal response preceding the onset of the target verbal response (coded as a 'false start' e.g., a yawn, cough, or laugh by the participant, and responses that started with a question or a comment by the participant that was not part of the target response), (b) program error (i.e., the software program used to present the priming pictures skipped an item), (c)

presentation of the wrong priming sentence by the experimenter (i.e., I read the wrong priming sentence or one that was not associated in its syntactic structure to the target picture). The total number of problematic responses was 107 (6.61 %) responses (64 false starts, 32 program skips, and 11 wrong sentences). Thus, following application of the first of the sentence exclusion criteria, 1510 sentences remained for analysis.

The second of the sentence exclusion criteria concerned response grammaticality. An 'ungrammatical response' was defined as one that was missing a main verb or parts or a verb (e.g., "A boy running,") or exhibited inaccurate word form or word choice (e.g., "The bulldozer is demoralizing the building," "The pedestrian got hit by a rescue,", and "The turtle wet the cat"). The total number of ungrammatical responses was 112 sentences (6.92 % of 1511 remaining responses). Thus, following application of the second of the exclusion criteria, 1398 sentences remained for analysis.

The third of the sentence exclusion criteria concerned examination of speech reaction time for each sentence produced by the participants. Recall that SRT in milliseconds for each participant was captured by the computer and was defined as the time from the onset of the presentation of the priming picture on the computer screen to the onset of verbal response by the participant captured by the voice activated microphone. To eliminate the effect of outlier SRT values, and after consultations with two committee members, I trimmed the SRT data by including only the SRT values that fell between 500 milliseconds, at the low end, and three standard deviations above the SRT mean value for a given participant, at the high end. Thus, all SRT values for grammatical sentences below 500 milliseconds as well as SRT values that fell 3 standard deviations above the mean SRT value for a participant were excluded from subsequent analyses. The total number of excluded SRT outliers was 63 sentences (3.89 % of 1398

remaining responses). Following the application of the third exclusion criteria 1335 sentences remained for analysis.

The fourth and last of the exclusion criteria concerned overall participant performance. One participant in the experimental group produced only two grammatical sentences out of the 54 possible responses thus resulting in only 2 usable sentences. As a result, responses for that participant were excluded from the final statistical analyses, as were response for the matched participant from the control group. Thus, in all, a total of 46 possible responses (produced by those two participants) or 2.84 % out of 1335 remaining responses were excluded from consideration. Accordingly, statistical analyses described in the subsequent sections are based upon sentences produced by the remaining 28 participants (14 PWNS and 14 PWS).

After all the sentence exclusion criteria were applied, the data file used to conduct all subsequent analyses included only grammatical sentences, that were (a) entirely accurate (i.e., they contained no false starts or evidence of program or experimenter errors) and (b) free from outlying SRT scores. Thus, 1289 responses were included in the final analyses. This number represented 79.71 % of the total set of responses that the participants originally produced.

General descriptive analyses

Each participant had the opportunity to produce 252 responses: 108 critical trials (i.e. repetitions of 54 priming sentences and generation of 54 sentences to describe target pictures), and 144 fillers (i.e., repetitions of 72 filler sentences and generation of sentences to describe each of the 72 filler pictures). Only picture descriptions during the critical trials were of interest in this study, thus the sentence fluency analyses were based on the 54 possible sentences generated by each participant to describe the priming pictures. All other responses (i.e., repetitions of priming and filler sentences and descriptions of filler pictures) were excluded from the final analyses.

Data preparation for speech fluency analyses

Each sentence produced by the participants was coded as to whether it was fluent or disfluent. Fluent sentences were those that did not contain 'repetitions and prolongations' as defined in (1) to (7) below and 'other' disfluency types as defined in (8) and (9) below:

1 Sound or syllable repetition: Instances at which the participant repeated a sound or syllable in a given word as in "The b boy is giving the girl a valentine's card," and "The bear is hiding behind the tree while the boy is look looking at the duck."

2 Monosyllabic word repetition: Instances at which the participant repeated a one-syllable word as in "The the man is cleaning the window".

3 Polysyllabic word repetition: Instances at which the participant repeated a word that contained more than one syllable as in "The hostess is serving serving drinks to her guests".

4 Phrase repetition: Instances at which the participant repeated a string of words within a sentence as in "The bee the bee is stinging a man".

5 Inaudible sound prolongation: Instances at which the participant seemed to start a word and "block" or exhibit difficulty moving from the initial sound or part of that word to the next sound as in "The p policeman is handing the man a ticket".

6 Audible sound prolongations: Instances at which the participant started a sound and vocalization of the sound could be heard as in "The fff firefighter is rescuing a baby from the fire".

7 Broken words: Instances at which participants produced a sound or syllable repetition or an inaudible sound prolongation at syllable divisions within a word as in " The construction worker drove the bull do dozer," and " The boy is hold ding a girl's hand".

8 Other" disfluency types: Interjections and revisions as in "Um, The construction worker drove the uh bulldozer".

9 Revisions: Instances at which the participant responded with a phrase or a sentence, stopped, and changed their choice of that phrase or sentence as in " A clier, a fireman is climbing out of a building" and "A girl is squirting a boy with a gun, with a squirt gun", and "A man and a woman, oh no, A man is looking at a baby and a woman is looking at the man".

Disfluent sentences produced by each group were further coded in terms of the position of the disfluency (e.g., 1st word, 1st noun phrase, etc.) within the response. This analysis was performed to be used in providing general descriptive data for fluency and was also used to guide

the manner in which statistical analyses for the SRT analyses were to be conducted (described in more detail below). Sentences that were produced with no disfluencies were coded as "fluent".

Overall, participants produced 646 entirely fluent sentences (50.11 %) and 643 disfluent sentences (49.88 %). In terms of group descriptive statistics, 76.22 % of sentences produced by PWNS were entirely fluent and 23.92% were disfluent. As expected, PWS showed a pattern that was nearly opposite the one that was observed for PWNS, that is, only 21.59% of the sentences produced by PWS were entirely fluent and 78.40 % were disfluent.

Data preparation for sentence type analyses

Following data preparation procedures similar to those used for the fluency analyses, sentence type analyses was based on the same 54 sentences generated by each participant to describe the priming pictures. All other responses (i.e., repetitions of priming and filler sentences and descriptions of filler pictures) were excluded from further analysis. Each of the 54 sentences produced by a participant was assigned to one of the following categories: 'Transitive' as in examples (1) and (2) above under 'Transitive priming sentences and pictures', 'Dative' as in examples (4) and (5) above under 'Dative priming sentences and pictures,' and 'Two-clause' as in examples (7), (8), and (9) above under 'Two-clause priming sentences and pictures.' If a sentence was coded as 'Transitive,' it was further coded as either 'active' or 'passive.' To be coded as an active, the sentence had to have an acceptable corresponding passive sentence form. A passive form had to include a passive verb (i.e., a main verb proceeded by a form 'be' or 'get' and followed by a 'by-phrase' (i.e., prepositional phrase starting with the preposition 'by'). For example, an active sentence was "The dog is chasing a mailman" and the corresponding passive sentence was "The mailman is chased by the dog" (see 'Transitive priming sentences and pictures' above for detailed description and examples of the active and passive sentence types).

Passive sentences that did not include the by-phrase were coded as 'other' (e.g., "A man is bitten in the arm").

If a sentence was coded as 'Dative', it was further coded as either 'prepositional dative', or 'double-object dative'. To be coded as 'Dative', the sentence had to have an acceptable corresponding double-object sentence form (see 'Dative priming sentences and pictures' above for detailed description and examples of the 'prepositional' and 'double-object' sentence types). Dative sentences had to include appropriate numbers of noun phrases indicating the three main actors in the depicted action (e.g., "The girl $^{(1)}$ is giving the man $^{(2)}$ a paint brush $^{(3)}$"). Dative sentences that did not include all three main actors (e.g., "The girl$^{(1)}$ read to the boy$^{(2)}$," as compared to " The girl$^{(1)}$, read a story$^{(2)}$, to the boy$^{(3)}$") were coded as 'other'. An additional category: 'dative + two-clause' was added to the 'Dative' sentence type analysis. The 'dative + two-clause' category was added to show that in some instances, the 'Dative' and 'Two-clause' categories were not mutually exclusive. If a sentence was coded as 'two-clause', it was further coded as either 'conjoined' or 'embedded.' (see 'Two-clause priming sentences and pictures' above for detailed description and examples of the 'conjoined' and 'embedded' sentence types). Finally, other sentences structures (i.e., non-transitive, reflexives, and predicative adjective sentences as in examples (10), (11), and (12) respectively above under Filler sentences pictures were coded as 'other'. The number of sentences produced per each examined sentence type is illustrated in Figure 2-1.

Pertaining to response length for each of the examined sentence types and as illustrated in Figure 2-2., on average, and for participants in the two study groups, transitive sentences were shortest in terms of both words (PWNS = 7.97, PWS = 7.74) and syllables (PWNS = 10.26, PWS

= 9.96) number, and two-clause sentences were longest (words: PWNS = 12.60, 12.63; syllables: PWNS = 15.43, PWS = 1620).

Data preparation for SRT analyses

SRTs for each of the sentences were coded online by the Direct-RT program. SRT was measured (in milliseconds) and defined as the time of picture (target or filler) presentation to the time of acoustic onset for participant's response. Recall that during picture description trials for both the target and filler pictures, the Direct-RT program generated and controlled the time at which pictures were presented. The program also recorded the latencies of the participant's vocal response, in milliseconds, for each of the pictures.

The overall mean SRT for PWNS was 2667.20 ms (S.D. 1252.28 ms) and for the PWS, was 2596.78 ms (S.D. 1532.33 ms). Based on these values, SRT for PWS was on average 70.42 ms shorter than SRT for PWNS.

In terms of data preparation for the SRT analyses per sentence type, it is worth mentioning that deciding on which responses to include in the SRT analyses was not entirely obvious. The difficulty in making this decision lies in the fact that when earlier studies used sentence structure priming methodology to examine structure priming effects in addition to SRT data, almost all these studies used a very rigid definition of what a fluent response is. For example, in Bock's studies (e.g., Bock, 1986; Bock 1989) that I reviewed, whenever a reference was made to what a fluent response is, the definition stated that such a response is one that was produced with no entirely fluent (i.e., exhibited no speech disfluencies such as interjections, revisions, hesitations, or sound or syllable repetitions). Note however, that none of the above-referenced studies by Bock examined SRT and fluency in PWS. As would be expected based on previous research, PWS on average produce significantly more disfluent responses than PWNS. As a result, when comparing sentence production between these two groups, and when participants in the two

groups are given equal opportunities to produce a similar number of responses, a percentage of those responses will be disfluent; however, a substantial number of the disfluent responses will be produced by the stuttering group. If such disfluent responses are excluded from a given analysis, this will in the end result in the loss of several data points for participants in both groups but substantially more for the participants in the stuttering group. In this study, out of 673 responses produced by PWNS, 513 (76.52%) were entirely fluent compared to 616 responses produced by PWS out of which only 133 (20.25%) were entirely fluent. Clearly, if this rigid definition of fluency is used in the present study, it would be necessary to exclude at least 4 of the 14 PWS and the sample means for many other participants would be based on fewer than 10 data points. For example, looking at the range for how many fluent transitive sentences were produced by each group, PWNS on average produced 13 fluent transitive sentences (range 6-18). PWS on the other hand produced on average about 4 fluent transitive sentences (range 0-10). The averages for the number of fluent dative and two-clause sentences show a similar pattern.

Compare this to when a more "lenient" definition of a fluent response is used. In this case, a fluent response is defined as one that exhibits no disfluencies within the first noun phrase in a sentence (NP1F). As illustrated in Figure 2-3, when using this definition, the number of responses that can be included in the analyses increases for the two groups, and almost doubles for PWS (547 responses when the sentences exhibiting a fluent first noun phrase were included in the analysis compared to only 133 when only entirely fluent responses were included). Using the number of transitive sentences again as an example, and when looking at the range for how many transitive sentences exhibiting a fluent first noun phrase were produced by each group, although the increase is not that dramatic for PWNS who on average produced 13 transitive sentences with a fluent first noun phrase, the percentage of sentences that can be included almost

doubles (40.93%) for PWS compared to when only entirely fluent sentences were examined (20.25%).

When yet, a broader definition is used for sentence inclusion (i.e., using all sentences that exhibited a fluent first word in the first noun phrase of a sentence), the percentage of sentences that can be included for PWS yet increases markedly (57.38%; on average, 9 sentences per PWS).

Thus, based on the above, and to objectively represent the results of any effects or interactions among the different variables in the present study, in addition to including as many responses as possible in the analyses, the reported SRT analyses and results are for sentences in which the first noun phrase in the sentence was fluent (NP1F). It was felt that such an approach would offer a reasonable compromise between being forced to use mean SRT values that were based on relatively few data points and using mean SRT values that might be conflated with sentence factors having to do with stuttering within the subject constituent of the first NP.

Intrajudge and Interjudge Measurement Reliability

All fluency and sentence type measures in this study were made by the author. Inter and intrajudge measurement reliability for sentence type were conducted by randomly selecting two participants and reanalyzing all the sentences produced by those two participants (total 108 sentences or 7 % of the data). I first recoded the 108 sentences for sentence type coding and then a graduate student who had a background in linguistics and who was familiar with the sentence type coding processes used in the study independently recoded each sentence for sentence type. Intrajudge analysis showed 99% agreement (disagreement was a coding error for one sentence), and interjudge analysis showed 98% agreement (disagreement was a coding error for two sentences). The interjudge points of disagreement were discussed and resolved.

Inter and intrajudge measurement reliability for fluency were conducted by randomly selecting two participants and reanalyzing all the sentences produced by those two participants (total 108 sentences or 7 % of the data). I first recoded the 108 responses for fluency (i.e., 'fluent' or 'disfluent') and then recoded the disfluent responses for type of disfluency (i.e., 'repetitions and prolongations,' 'other') and position of disfluencies within response (i.e., 1st word, 1st noun phrase, etc.). Then an undergraduate student who was familiar with the fluency coding processes used in the study independently recoded each response for fluency. Intrajudge analysis showed 98% agreement, and interjudge analysis showed 94% agreement. The points of disagreement were discussed and resolved.

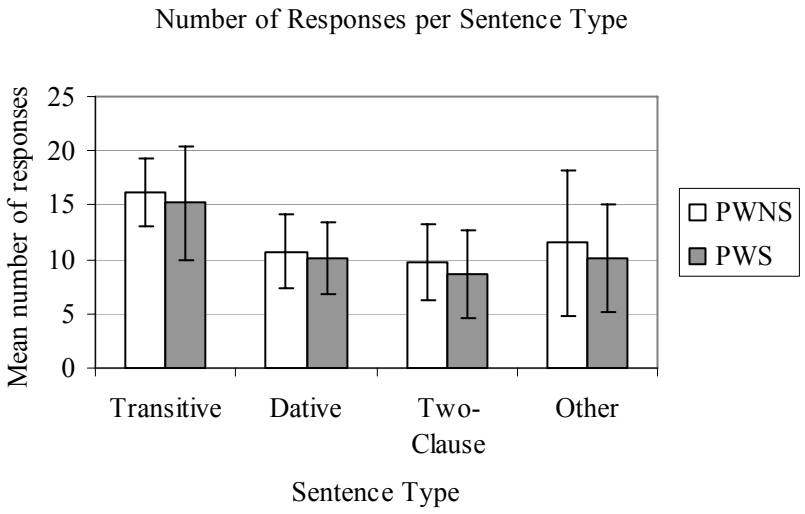


Figure 2-1. The mean and standard deviation for the number of responses produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) across the examined sentence types (Transitive, Dative, and Two-Clause) in addition to responses that exhibited syntactic structures other than the examined types (Other).

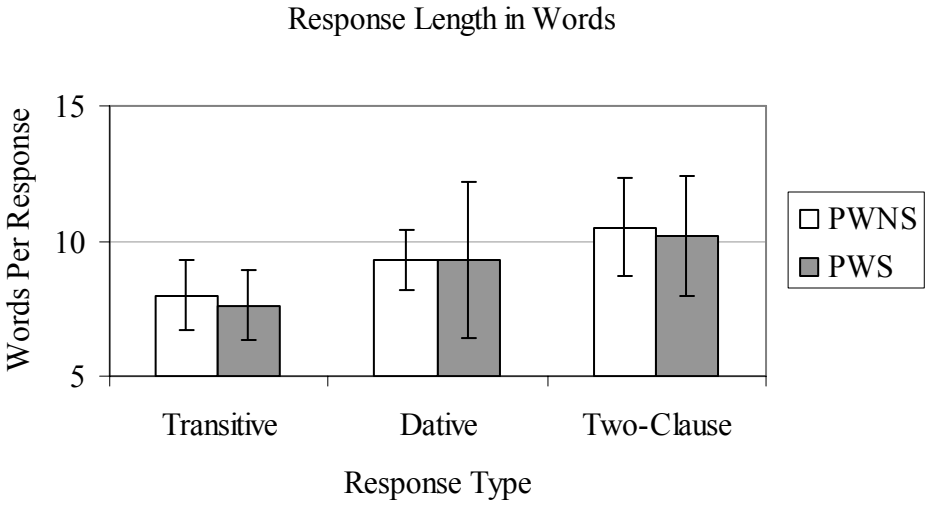


Figure 2-2 Mean and standard deviation for number of words produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) for (a) Transitive responses in the Transitive experiment, (b) Dative responses in the Dative experiment, and (c) Two-Clause responses in the Two-Clause experiment.

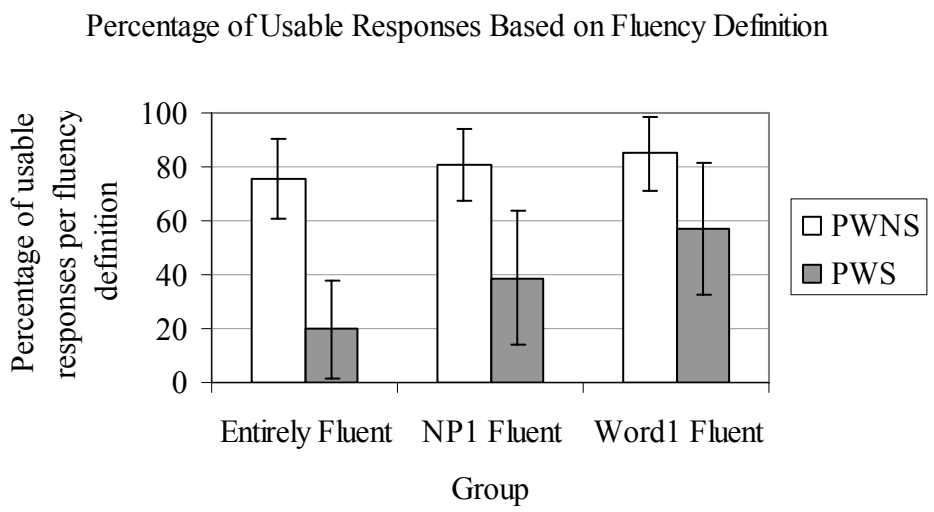


Figure 2-3. The mean and standard deviation for the percentage of sentences produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) when the sentence was entirely fluent, when the first noun phrase in the sentence was fluent, and when the first word in the first noun phrase in the sentence was fluent

Table 2-1. Participant Demographics and Performance on the Pre-study Language and Memory Tests

ID Number	Age	Gender	Years of Education	Digits Forward Max = 14	Digits Backward Max = 14	Digit Ordering Max = 24	WAIS-Vocabulary Max = 70	Stuttering Severity Level	Stuttering Treatment
S02	40	F	14	5	5	17	54	Severe	No
S03	21	F	15	7	5	12	62	Moderate-Severe	Yes
S04	34.8	F	16	10	7	14	60	Moderate	Yes
S05	24.1	M	17	12	7	21	50	Severe	Yes
S06	18.2	M	12	14	14	22	61	Mild	Yes
S07	19	M	13	12	6	20	56	Severe	Yes
S08	54.1	M	17	7	6	20	60	Moderate-Severe	Yes
S09	29.4	M	17	11	12	17	66	Moderate	Yes
S10	44.7	M	17	10	9	21	68	Moderate-Severe	Yes
S11	56	M	12	13	4	16	40	severe	Yes
S12	18	M	13	5	8	17	38	Moderate	Yes
S13	27	M	17	7	6	12	34	Moderate	Yes
S14	44.1	F	19	6	4	15	43	Moderate	Yes
S15	59.8	M	19	14	9	17	64	Severe	Yes
NS01	21.4	M	17	10	6	23	58	NA	NA
NS02	22.1	M	17	8	6	18	58	NA	NA
NS03	34	F	20	14	13	21	69	NA	NA
NS04	21	F	17	8	8	21	48	NA	NA
NS05	27.2	M	21	12	13	24	62	NA	NA
NS06	21.8	M	16	11	8	22	65	NA	NA
NS07	24	M	17	8	8	18	62	NA	NA
NS08	26.8	M	20	13	12	22	69	NA	NA
NS09	43.1	M	18	14	8	21	69	NA	NA
NS10	59.3	M	21	12	12	16	64	NA	NA
NS11	34.9	F	29	13	10	23	69	NA	NA
NS12	53	M	14	6	6	14	53	NA	NA
NS13	43	F	14	11	5	21	69	NA	NA
NS14	24	M	17	13	12	22	64	NA	NA

CHAPTER 3
RESULTS

Recall that in this study, I was interested in examining the differences between adults who stutter and adults who do not stutter in speech fluency, speech reaction time, and responses to priming across sentences varying in their syntactic structure. Several analyses were conducted to examine differences between the two groups in (a) the overall frequency of disfluencies they produced, (b) the frequency of disfluencies produced pertaining to sentences of varying syntactic structure, (c) the effect of priming on the frequency of disfluencies they produced, (d) the extent to which syntactically primed structures were incorporated into responses, (e) overall mean SRTs, and (f) mean SRT for each of several sentence types.

This chapter on results is organized into three main subsections that are based on the analyses performed to address the above points. The first subsection deals with the fluency analyses. In this section, results pertaining to the statistical analyses that address points (a) and (b) above are described. The second subsection deals with syntactic priming analyses. In this section, results pertaining to the statistical analyses used to address points (c) and (d) above are described. The third subsection deals with the speech reaction time analyses. In this section, results pertaining to the statistical analyses used to address points (e) and (f) above are described.

Fluency-Related Results

Three analyses were used to answer the fluency-related questions. The analyses were based on the three sentence type experiments in the present study (i.e., Transitive, Dative, and Two-clause). The first analysis examined the frequency and type of speech disfluencies produced by each group during the Transitive experiment across the different prime types (i.e., active, locative, and passive primes). The second analysis examined the frequency and type of speech disfluencies produced by each group during the Dative experiment across prime types (i.e.,

double-object, object-complement, and prepositional object primes). The third analysis examined the frequency and type of speech disfluencies produced by each group during the Two-Clause experiment across the different prime types (i.e., conjoined, center-embedded, and right-embedded primes). A fourth analysis was conducted to compare the frequency and type of speech disfluencies produced by each group across the three experiments (i.e., Transitive, Dative, and Two-Clause). In the remainder of this section, results of these four analyses are presented.

Transitive Experiment

Figure 3-1a shows the frequency with which 'repetitions and prolongations' and 'other' types of disfluencies were produced by participants in the two groups in the Transitive experiment. As can be seen, overall, the PWS seemed to produce more 'repetitions and prolongations' across the three examined transitive conditions (i.e., active, locative, passive) than the PWNS.

To examine fluency in the Transitive experiment, a 2 (Group) × 2 (Disfluency Type) × 3 (Prime Type) multivariate analysis of variance (MANOVA) was conducted, with Group (PWNS, PWS) as the between-subjects factor and Disfluency Type ('repetitions and prolongations', 'other') and Prime Type (Active, Locative, Passive) as within-subjects factors. The dependent variable was the frequency of 'repetitions and prolongations' and 'other' types of disfluencies the participants produced per Transitive prime type.

The main effect for the within-subjects factor Disfluency Type was significant (F (1, 26) = 16.562, $p < 0.001$, $\eta^2 = 0.389$) and the Group × Disfluency Type interaction was also significant (F (1, 26) = 24.143, $p < 0.001$, $\eta^2 = 0.481$) indicating that the difference between the frequency of 'repetitions and prolongations' and the frequency of 'other' disfluencies per response for one study group were different from those frequencies for the other study group. The main effect of

the between-subjects factor, Group was also significant (F (1,26) = 34.50, $p < 0.001$, $\eta = 0.57$) indicating that the PWS produced significantly more overall speech disfluencies in the transitive responses ($M = 0.80$) than the PWNS ($M = 0.11$).

To further examine the Group × Disfluency interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., frequency of 'repetitions and prolongations' and 'other' types of disfluencies) in the following experimental condition pairs to determine which were significantly different:

- 'Repetitions and prolongations' produced by PWNS versus 'repetitions and prolongations' produced by PWS
- 'Other' disfluencies produced by PWNS versus 'other' disfluencies produced by PWS

A Bonferroni-corrected alpha was used to control Type I error (alpha levels .05/2 t tests = .025). The results of one comparison was significant indicating that the PWNS produced significantly fewer 'repetitions and prolongations' per response following the transitive primes examined in the present study ($M = 0.067$) than PWS ($M = 1.28$) (t (26) = -5.864, two-tailed $p < 0.001$). The results of the other comparison was not significance (t (26) = -1.898, two-tailed $p = 0.069$) indicating that although PWNS produced fewer 'other' types of disfluencies in the transitive responses following the transitive primes examined in the present study than PWS, the difference in the frequency of 'other' types of disfluencies was not significant between the two groups.

None of the results of the Prime Type analyses for the transitive experiment were significant, indicating that, for all participants, the transitive prime types examined in the present study did not seem to affect the frequency of 'repetitions and prolongations' versus 'other' disfluency types produced in responses to those primes.

In summary, the results of the Transitive experiment analyses indicated that PWS produced significantly more ‘repetitions and prolongations’ than PWNS. The results also indicated that participants in the two study groups produced a comparable number of ‘other’ disfluencies in responses following the transitive primes examined in the present study. In addition, the results indicated that for all participants, the frequency and type of speech disfluencies produced in the transitive responses did not seem to be affected by whether or not the priming sentences preceding those responses exhibited an active, locative, or passive transitive sentence structure.

Dative Experiment

Figure 3-1b shows the frequency with which ‘repetitions and prolongations’ and ‘other’ types of disfluencies were produced by participants in the two groups in the Dative experiment. As can be seen, overall, the PWS seemed to produce more ‘repetitions and prolongations’ across the three examined dative conditions (i.e., double-object, object-complement, prepositional-object) than the PWNS.

To examine fluency in the Dative experiment, a 2 (Group) × 2 (Disfluency Type) × 3 (Prime Type) MANOVA was conducted, with Group (PWNS, PWS) as the between- subjects factor and Disfluency Type (‘repetitions and prolongations’, ‘other’) and Prime Type (Double-object, Object-complement, Prepositional object) as the within-subjects factors. The dependent variable was the frequency of ‘repetitions and prolongations’ and ‘other’ types of disfluencies the participants produced per Dative prime type.

Consistent with results from the Transitive experiment, the main effect for the within-subjects factor, Disfluency Type, was significant (F (1, 26) = 19.912, $p < 0.001$, $\eta^2 = 0.434$) and the Group × Disfluency Type interaction was also significant (F (1, 26) = 21.638, $p < 0.001$, $\eta^2 = 0.454$), indicating that the difference between the frequency of ‘repetitions and prolongations’

and the frequency of ‘other’ disfluencies per response type for one study group were different from those frequencies for the other study group. The main effect of the between-subjects factor, Group was also significant (F (1, 26) = 32.863, $p < 0.001$, $\eta = 0.55$) indicating that the PWS produced significantly more overall speech disfluencies for their dative responses ($M = 0.90$) than the PWNS ($M = 0.11$).

To further examine the Group × Disfluency interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., frequency of ‘repetitions and prolongations’ and ‘other’ types of disfluencies) in the following experimental condition pairs to determine which were significantly different:

- ‘Repetitions and prolongations’ produced by PWNS versus ‘repetitions and prolongations’ produced by PWS
- ‘Other’ disfluencies produced by PWNS versus ‘other’ disfluencies produced by PWS

A Bonferroni-corrected alpha was used to control Type I error (alpha levels .05/2 t tests = .025). The results of one comparison was significant indicating that the PWNS produced significantly fewer ‘repetitions and prolongations’ ($M = 0.100$) per dative primes than PWS ($M = 1.54$) (t (26) = -5.577, two-tailed $p < 0.001$). The results of the other comparison was not significant indicated that following the dative primes examined in the present study, participants in the two study groups produced a comparable number of ‘other’ types of disfluencies per dative response (PWNS $M = 0.12$, PWS $M = 0.26$) ($t(26) = -2.017$, two-tailed $p = 0.065$).

None of the results of the Prime Type analyses were significant indicating that for all participants, the dative prime types examined in the present study did not seem to affect the frequency of ‘repetitions and prolongations’ versus ‘other’ disfluency types produced in responses to those primes.

In summary, the results of the Dative experiment analyses indicated that PWS produced significantly more ‘repetitions and prolongations’ than PWNS. The results also indicated that participants in the two study groups produced a comparable number of ‘other’ types of disfluencies. Additionally, the results indicated that for all participants, the frequency and type of speech disfluencies produced in the dative responses did not seem to be affected by whether or not the priming sentences preceding those responses exhibited a double-object, object-complement, or prepositional object dative sentence structure.

Two-Clause Experiment

Figure 3-1c shows the frequency with which ‘repetitions and prolongations’ and ‘other’ types of disfluencies were produced by participants in the two groups in the Two-Clause experiment. As can be seen, overall, and similar to the results of the two previous analyses, overall, the PWS seemed to produce more ‘repetitions and prolongations’ across the three examined two-clause conditions (i.e., conjoined, center-embedded, right-embedded) than the PWNS.

To examine fluency in the Two-Clause experiment, a 2 (Group) × 2 (Disfluency Type) × 2 (Prime Type) MANOVA was conducted, with Group (PWNS, PWS) as a between-subjects factor and Disfluency Type (‘repetitions and prolongations’, ‘other’) and Prime Type (Right embedded, Center embedded, and Conjoined) as the within-subjects factors. The dependent variable was the frequency of ‘repetitions and prolongations’ and ‘other’ types of disfluencies per response type.

Similar to the results of the Transitive and Dative experiments analyses, the main effect for the within-subjects factor Disfluency Type was significant (F (1, 26) = 34.809, $p < 0.001$ $\eta^2 = 0.572$) and the Group × Disfluency Type interaction was also significant (F (1, 26) = 31.603, $p < 0.001$, $\eta^2 = 0.549$) indicating, once again, that the difference between the frequency of

‘repetitions and prolongations’ and the frequency of ‘other’ disfluencies per response type for one study group were different from those frequencies for the other study group. The main effect of the between-subjects factor, Group was also significant (F (1, 26) = 32.86, $p < 0.001$, η = 0.55) indicating that the PWS produced significantly more overall speech disfluencies their two-clause responses (M = 0.87) than the PWNS (M = 0.20).

To further examine the Group × Disfluency Type interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., frequency of ‘repetitions and prolongations’ and ‘other’ types of disfluencies) in the following experimental condition pairs to determine which were significantly different:

- ‘Repetitions and prolongations’ produced by PWNS versus ‘repetitions and prolongations’ produced by PWS
- ‘Other’ disfluencies produced by PWNS versus ‘other’ disfluencies produced by PWS

A Bonferroni-corrected alpha was used to control Type I error (alpha levels .05/2 t tests = .025). Similar to the results of the two previous analyses, the results of one comparison was significant indicated that the PWNS produced significantly fewer ‘repetitions and prolongations’ per two-clause responses examined in the present study (M = 0.21) than PWS (M = 1.46) (t (26) = -6.249, two-tailed $p < 0.001$) and that the number of ‘other’ types of disfluencies per response was similar between the two groups.

As with the two other experiments, none of the results for the Prime Type analyses were significant indicating that for all participants, the two-clause prime types examined in the present study did not seem to affect the frequency of ‘repetitions and prolongations’ versus ‘other’ disfluency types produced in responses to those primes.

In summary the results of the Two-Clause experiment analyses indicated that PWS produced more ‘repetitions and prolongations’ than PWNS. The results also indicated that

participants in the two study groups produced a comparable number of ‘other’ types of disfluency in responses following the two-clause primes examined in the present study. In addition, the results indicated that for all participants, the frequency and type of speech disfluencies produced in the two-clause responses did not seem to be affected by whether or not the priming sentences preceding those responses exhibited a right embedded, center embedded, or conjoined two-clause sentence structure.

Fluency Across Picture Types

Before describing this analysis in detail, it is worth mentioning that although the present analysis and three above analyses may seem similar, the present analysis examined the overall effect of picture type (i.e., whether a picture was designed to elicit a Transitive, Dative, or Two-Clause sentence) on the frequency and type of disfluencies between the two groups. In contrast, the three previous analyses examined the effect of a given prime type (e.g., Transitive: Active, Locative, Passive) on the frequency and type of speech disfluencies within that experiment.

Figure 3-2 shows the frequency with which ‘repetitions and prolongations’ and ‘other’ types of disfluencies were produced by participants in the two groups in responses to different picture types across the three experiments (i.e., Transitive, Dative, and Two-Clause). As can be seen, overall, the PWS produced somewhat more ‘repetitions and prolongations’ ($M = 1.47$) and more than the PWNS ($M = 0.12$) across the three examined picture types.

To examine participants’ fluency across the picture types used in the three experiments, a 2 (Group) × 2 (Disfluency Type) × 3 (Picture Type) MANOVA was conducted, with Group (PWNS, PWS) as a between-subjects factor and Disfluency Type (‘repetitions and prolongations’, ‘other’) and Picture Type (Transitive, Dative, Two-clause) as within-subjects factors. The dependent variable was the frequency of each type of disfluency per trial.

The main effect of the within-subjects factor, Disfluency Type, was significant (F (1, 26) = 23.009, $p < 0.001$, $\eta^2 = 0.469$) indicating that for all participants, the frequency of 'repetitions and prolongations' was different from the frequency of 'other' types of disfluencies. The Group × Disfluency Type interaction was also significant (F (1, 26) = 24.893, $p < 0.001$, $\eta^2 = 0.489$) indicating that that the frequency of 'repetitions and prolongations' versus 'other' types of disfluencies for one study group was different from that frequency for the other study group. The main effect of the between-subjects factor Group was also significant (F (1, 26) = 38.613, $p < 0.001$, $\eta^2 = 0.598$) indicating that overall, the PWS produced significantly more speech disfluencies per response (M = 0.89) than the PWNS (M = 0.13).

To further examine the Group × Disfluency Type interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., frequency of 'repetitions and prolongations' and 'other' types of disfluencies) in the following experimental condition pairs to determine which were significantly different:

- 'Repetitions and prolongations' versus 'other' disfluencies produced by PWNS
- 'Repetitions and prolongations' versus 'other' disfluencies produced by PWS
- 'Repetitions and prolongations' produced by PWNS versus 'repetitions and prolongations' produced by PWS
- 'Other' disfluencies produced by PWNS versus 'other' disfluencies produced by PWS

A Bonferroni-corrected alpha was used to control Type I error (alpha levels .05/4 t tests = .0125). The results indicated that the PWS produced significantly more 'repetitions and prolongations' (M = 0.13) than 'other' disfluencies (M = 0.29) per response following the picture types used in the present study, (t (13) = 5.860, two-tailed $p < 0.001$). The comparison for the PWNS was not significant indicating that the PWNS produced a comparable number of 'repetitions and prolongations' and 'other' types of disfluencies in responses following the

picture types used in the present study. In addition, the results indicated that when comparing the two groups in terms of the types of disfluencies they produced, the PWNS produced significantly fewer 'repetitions and prolongations' ($M = 0.12$) per response than the PWS ($M = 1.47$) (t (13) = -7.139, two-tailed $p < 0.001$), but the difference between the groups in the numbers of 'other' disfluencies was not statistically significant (PWNS $M = 0.14$, PWS $M = 0.31$).

The main effect for the within-subjects factor, Picture Type, approached significance (F (2, 52) = 3.007, $p = 0.058$) and the Picture Type × Group interaction (F (2, 52) = 1.295, $p = 0.283$) was not significant, indicating that although the PWS produced more speech disfluencies than PWNS, all participants seemed to produce overall fewer speech disfluencies per response following two-clause primes ($M = 0.45$) than speech disfluencies in responses following both transitive ($M = 0.54$) and dative ($M = 0.54$) primes.

There was a significant Disfluency Type × Picture Type interaction (F (2, 52) = 3.377, = 0.042, $\eta^2 = 0.115$). However, the Disfluency Type × Picture Type × Group interaction was not significant (F (2, 52) = 1.446, $p = 0.245$) indicating that although picture type seemed to affect fluency, it did not seem to affect the type of speech disfluency differently between study groups.

To further examine the Disfluency Type × Picture Type interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., frequency of 'repetitions and prolongations' versus 'other' types of disfluencies) across the three prime types to determine which were significantly different:

- 'Repetitions and prolongations' in responses following Transitive versus Dative pictures
- 'Repetitions and prolongations' in responses following Transitive versus Two-Clause pictures
- 'Repetitions and prolongations' in responses following Dative versus Two-Clause pictures
- 'Other' disfluencies in responses following Transitive versus Dative pictures

- ‘Other’ disfluencies in responses following Transitive versus Two-Clause pictures
- ‘Other’ disfluencies n responses following Dative versus Two-Clause pictures

A Bonferroni-corrected alpha was used to control Type I error (alpha levels .05/6 *t* tests = .008). The result of only one paired comparison was significant, indicting that participants in the two study groups produced significantly fewer speech disfluencies in responses to the Transitive picture types ($M = 0.45$) than in responses to Two-Clause picture types ($M = 0.54$) (t (27) = -2.945, two-tailed $p = 0.007$).

In summary the results of the Picture Type analyses indicated that when responding to the transitive, dative, and two-clause pictures examined in the present study, PWS produced significantly more speech disfluencies than PWNS. Additionally, participants in the two study groups produced significantly more overall disfluencies in responses following the two-clause primes than in responses following the transitive and dative primes.

Priming Analyses

Similar to the procedures used in the fluency analysis described above, three analyses were used to answer the priming related questions. Recall that these analyses were based on the three experimental conditions (i.e., Transitive, Dative, and Two-clause). The first analysis examined the percentage with which passive responses were produced following active, locative, and passive primes in the Transitive experiment. The second analysis examined the percentage with which prepositional object dative responses were produced following double-object, object-complement, and prepositional object dative primes in the Dative experiment. The third analysis examined the percentage with which embedded responses were produced following right-embedded, center-embedded and conjoined responses in the Two-Clause experiment. The remainder of this section presents the results of these three analyses.

Transitive

Figure 3-3a shows the percentage with which passive responses were produced by participants in the two groups following the presentation of active, locative, and passive primes. As can be seen, the observed percentage of passive responses overall and passive responses to passive primes for the PWNS was somewhat higher (M = 23%) than it was for the PWS (M = 12%). As will be shown in this section, the results of the statistical analyses examining these overall and specific differences in the percentage of passive responses between the groups were not statistically significant.

Priming-related analyses for the Transitive experiment were conducted using a 2 (Group) x 3 (Prime Type) mixed model analysis of variance (ANOVA). Group (PWNS, PWS) was the between-subjects factor, and Prime Type (Active, Locative, and Passive) was the within-subjects factor. The dependent variable was the percentage of sentences produced as full passives (i.e., the responses had to include a form of *to be* plus a *by* phrase) in the Transitive experiment. Results showed no main effect for the within-subjects factor Prime Type (F (2, 52) = 0.845, p = 0.435), no Prime Type × Group interaction (F (2, 52) = 0.498, p = 0.611) and no main effect for the between-subjects factor Group (F (1, 26) = 0.813, p = 0.375) indicating that participants in the two study groups produced a comparable number of passive responses after active, locative, and passive primes.

Dative

Figure 3-3b shows the percentage with which prepositional dative responses were produced by participants in the two groups following the presentation of a double-object, object-complement, and prepositional-object dative primes. As can be seen, the observed percentage of prepositional-object responses to other dative responses for the PWS was somewhat higher for two of the dative prime conditions (Prepositional-object responses following double-object

primes *M* = 43% and prepositional-object responses following prepositional-object primes M = 54%) than they were for the PWNS (*M* = 18% and 49% respectively). and prepositional-object responses following prepositional-object primes M = 54%). As will be shown in this section, the results of a number of the statistical analyses examining these overall and specific differences in the percentage of prepositional-object responses between the groups were statistically significant

Priming-related analyses for the Dative experiment were conducted using a 2 (Group) x 3 (Prime Type) mixed ANOVA. Group (PWNS, PWS) was the between-subjects factor, and Prime Type (Double-Object, Object-Complement, Prepositional-Object dative) was the within-subjects factor. The dependent variable was the percentage of prepositional object dative responses in the Dative experiment. Results showed a significant main effect for the within-subjects factor, Prime Type, (F (2, 52) = 9.455, $p < 0.001$, η2 = 0.267), and a Prime Type × Group interaction (F (2, 52) = 3.914, $p = 0.026$, $\eta^2 = 0.131$) indicating that participants in one study group produced more prepositional-object dative responses following at least one prime type than participants in the other study group.

To further examine the main effect of Prime Type, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., the percentage of prepositional-object dative responses) in the following priming type pairs to determine which were significantly different:

- Double-object versus object-complement primes
- Double-object versus prepositional-object responses
- Object-complement versus prepositional-object responses

A Bonferroni-corrected alpha was used to control Type I error (alpha levels = .05/3 *t* tests = .016). The results indicated that all participants produced significantly more prepositional-object responses following prepositional-object primes (*M* = 52%) than following object-

complement primes (M = 23%) (t(27) = - 4.191, two-tailed $p < 0.001$) and following double-object primes (M = 33%) (t(27) = - 4.191, two-tailed $p = 0.016$)

To further examine the Prime Type × Group interaction, post-hoc paired-samples t tests were run comparing the within-subjects factor (i.e., the percentage of prepositional object dative responses) in the following priming type pairs to determine which were significantly different:

- Responses produced by PWNS following double-object versus object-complement primes
- Responses produced by PWNS following double-object versus prepositional-object primes
- Responses produced by PWNS following object-complement versus prepositional-object primes
- Responses produced by PWS following double-object versus object-complement primes
- Responses produced by PWS following double-object versus prepositional-object primes
- Responses produced by PWS following object-complement versus prepositional-object primes
- Responses produced by PWNS versus PWS following double-object primes
- Responses produced by PWNS versus PWS following object-complement primes
- Responses produced by PWNS versus PWS following prepositional-object primes

A Bonferroni-corrected alpha was used to control Type I error (alpha levels = .05/9 t tests = .005). Pertaining to the PWNS, none of the results of the paired comparisons were significant. In detail, although the PWNS produced relatively fewer prepositional-object responses following double-object primes (18%) than following prepositional-object primes (49%), the difference between the two responses was not statistically significant (t (13) = -2.440, two-tailed $p = 0.030$). Similarly, and although the PWNS produced fewer prepositional-object responses following object-complement primes (30%) than following prepositional-object primes, the difference between the two responses for the PWNS was not statistically significant (t(13) = -2.181, two-tailed $p = 0.048$). Thus the results indicated that although the PWNS produced more

prepositional-object responses following prepositional-object primes and following object-complement primes than following double-object primes, the percentage of prepositional-object dative responses produced by the PWNS was not significantly affected by the type of the dative primes preceding those responses. Alternately, the results of only one paired-comparison for the PWS were significant. Namely, PWS produced significantly fewer prepositional-object responses following object-complement primes (16%) than prepositional-object responses following prepositional-object primes (54%) (t (13) = -3.762, two-tailed p = 0.002). The result of another paired-comparison (prepositional-object responses following double-object primes versus following object-complement primes) only approached significance (t (13) = 3.251, two-tailed p = 0.006). Thus, for the PWS, the percentage of prepositional-object responses was affected by the type of dative prime preceding those responses. Specifically, the PWS produced the significantly more prepositional-object responses following prepositional-object primes (54%) than following object-complement primes (16%). Although the PWS seemed to produce a more prepositional-object responses following prepositional-object than following double-object primes, the difference between the frequencies of prepositional-object responses for this examined comparison was not statistically significant. In terms of comparisons between the two groups, none of the results of the paired-tests were significant indicating that although there were differences between the two groups in the frequency of prepositional-object responses following the examined dative primes, the frequency of prepositional-object responses following the different dative primes examined in the present study was comparable between the two study groups.

In summary, the results of the priming type in the Dative experiment indicated that overall, participants tended to produce more prepositional-object responses following prepositional-

object primes than any other dative primes. The results also indicated differences between the two groups in the frequency of prepositional-object responses based on the structure of the prime. Specifically for the PWNS, the type of dative prime did not seem to significantly affect the probability using the prepositional-object prime in the response. In addition, the PWNS appeared to produce more prepositional-object responses following prepositional-object and object-complement primes than following double-object primes, although none of the differences were statistically significant. The PWS on the other hand tended to produce more prepositional-object responses following double-object primes (the frequency was not significant compared to the frequencies following the other primes), and significantly more such responses following prepositional-object primes than following object-complement primes.

Two-Clause

Figure 3-3c shows the percentage with which various types of responses were produced by participants in the two groups following presentation of a two-clause prime sentence. As can be seen, the observed percentage of responses with embedded clauses was different between the two groups; the PWNS produced complex sentences more frequently (M = 61%) than the PWS (M = 42%). As will be shown in this section, the results of the statistical analyses examining these overall and specific differences in the percentage of embedded responses between the groups were not statistically significant

Priming-related analyses for the Two-Clause experiment were conducted using a 2 (Group) x 3 (Prime Type) mixed model ANOVA. Group (PWNS, PWS) was the between-subjects factor, and Prime Type (Conjoined, Right-Embedded, and Center-Embedded) was the within-subjects factor. The dependent variable was the percentage of complex sentence responses in the Two-Clause experiment. Results showed no significant main effect for the within-subjects factor, Prime Type (F (2, 52) = 0.548, p = 0.581), and no Prime Type × Group interaction (F (2, 52) =

0.788, $p = 0.460$). The main effect for the between-subjects factor Group approached significance (F (1, 26) = 3.896, p= 0.059), indicating a variable response pattern across participants for embedded clauses.

Summary of the Priming Analyses

In the Transitive experiment, the results indicated that overall, participants produced a comparable number of passive responses following active, locative, and passive priming sentences. In the Dative experiment, the results indicated that there were differences between the two groups in the percentage of prepositional-object responses based on the type of the dative prime. Specifically and for the PWS, significantly more prepositional-object responses were produced following prepositional-object primes than following object-complement primes. Finally, in the Two-Clause experiment, the results indicated that although their was a trend toward PWNS producing more embedded responses than PWS, prime type (i.e., conjoined sentences versus sentences with embedded clauses) did not affect the type of sentence produced by either group.

SRT Analyses

Before describing the analyses used to examine SRT, it is worth mentioning that the original plan was to look at SRT within the response types associated with each experiment (i.e., Transitive experiment: active, locative, and passive response types; Dative experiment: double-object, object-complement, and prepositional object response types; Two-Clause experiment: conjoined, right-embedded, and center-embedded response types), in addition to the congruency of these responses with the priming sentence (e.g., frequency of passive responses following a passive priming sentence). Recall also that only fluent responses were included in the SRT analysis. For the purposes of this analysis, “fluent responses” were defined as those responses for which at least the first noun phrase contained no instances of disfluency (i.e., responses that

followed the more “lenient” fluency definition described in the Methods chapter). When the fluency-related criterion (i.e., including only responses for which NP1 was produced fluently) was applied across the categories of response types, many of the response type cells, particularly for PWS, contained no data points. Consequently, data were collapsed and examined together within each of the three experiments. Collapsing the data in this manner did not allow for examination of SRT in terms of priming. Thus, the results reported in this subsection are for SRT across the three prime types regardless of whether or not the responses matched the structure of the exact the prime. Specifically, in the Transitive experiment, overall SRTs for responses that exhibited a transitive sentence structure were examined without detailed examination and comparison of SRTs for active versus locative versus passive responses. That is, overall SRTs for the Transitive prime type were examined without comparing SRTs across the specific active, locative, or passive transitive primes. Similarly, in the Dative experiment, overall SRTs for responses that exhibited a dative sentence structure were examined regardless of the priming condition in which they occurred. That is, overall SRTs for the Dative prime type were examined without comparing SRTs across the specific double-object, object-complement, or prepositional-object dative primes. Similarly, and in the Two-Clause experiment, overall SRTs for two-clause for responses were examined regardless of the prime condition in which they occurred. That is, SRTs for the Two-Clause prime type were examined without comparing SRTs across the specific conjoined, right-embedded, or center-embedded two-clause primes.

Figure 3-4 shows the mean and standard deviations for SRT for response types across the three experiments (i.e., responses that were transitive in the Transitive experiment, responses that were dative in the Dative experiment and responses that were two-clause in the Two-Clause experiment). As can be seen, when the responses exhibited a transitive sentence structure, SRTs

for the PWS were somewhat shorter (M = 2274.69 ms) than SRTs for PWNS (M = 2372.97 ms). A similar difference and direction of the difference in SRT between the two groups can be also seen when responses exhibited a dative sentence structure (PWS M = 2404.25 ms, PWNS M = 2604.89 ms) and a two-clause sentence structure (PWS M = 2638.41 ms, PWNS M = 2780.76 ms). As will be shown, the results of the statistical analyses described in this section revealed that these observed differences between the two groups were not statistically significant.

Two questions were asked to answer the study questions pertaining to SRT in relation to speaker group and response type. The first question considered whether there was a difference between PWS and PWNS in overall SRT. The second question asked if response type (i.e., transitive, dative, two-clause) affected speech reaction times of PWS and PWNS similarly.

To determine whether there were significant differences between the two groups in SRT, in addition to any possible difference between the groups in mean SRT for the different response types, a 2 (Group) × 3 (Response Type) repeated measures ANOVA was used. Group (PWNS, PWS) was the between-subjects factor and Response Type (responses that were transitive in the Transitive experiment, responses that were dative in the Dative experiment, and responses that were two-clause in the Two-Clause experiment) was the within-subjects factor. As stated above, the analyses included entirely fluent responses in addition to ones that had a fluent first noun phrase. The puerility assumption was tested but was not met (χ^2 (2) = 11.615, p = 0.003). Thus, the reported statistics are for the Huynh-Felt correction. There was a significant main effect for the within-subjects factor, Response Type, (F (1.58, 41.13) = 14.654, $p < .001$, $\eta^2 = .360$). However, there was no significant main effect for the between-subjects factor, Group (F (1, 26) = 0.302, p = 0.587), and no significant Group × Response Type interaction, (F (1.58, 41.13) =

.259, $p = 0.721$). Thus, for all participants, there was a difference in SRT in the responses they produced for at least one of the response types examined in the present study.

To further examine the main effect of Response Type, post-hoc paired-samples *t* tests were run comparing the within-subjects factor (i.e., SRTs for transitive responses in the Transitive experiment, dative responses in the Dative experiment, and two-clause responses in the Two-Clause experiment) in the following response type pairs to determine which were significantly different:

- Transitive versus dative
- Transitive versus two-clause
- Dative versus two-clause

A Bonferroni-corrected alpha was used to control Type I error (alpha levels = .05/3 *t* tests = .016). The results of all paired comparisons were significant. In detail, the results indicated that and for all participants, when producing sentences in which at least the first noun phrase was fluent, SRTs for sentences exhibiting a transitive sentence structure were faster ($M = 2323$ ms) than SRTs for sentences exhibiting a dative structure ($M = 2504$ ms) (t (27) = -4.029, two-tailed $p < 0.001$) and were also faster than SRTs for sentences exhibiting a two-clause structure ($M = 2709$ ms) (t (27) = -4.770, two-tailed $p < 0.001$). In addition, SRTs for sentences exhibiting a dative structure were faster ($M = 2504$ ms) than SRTs for sentences exhibiting a two-clause structure ($M = 2709$ ms) (t (27) = -2.587, two-tailed $p = 0.015$).

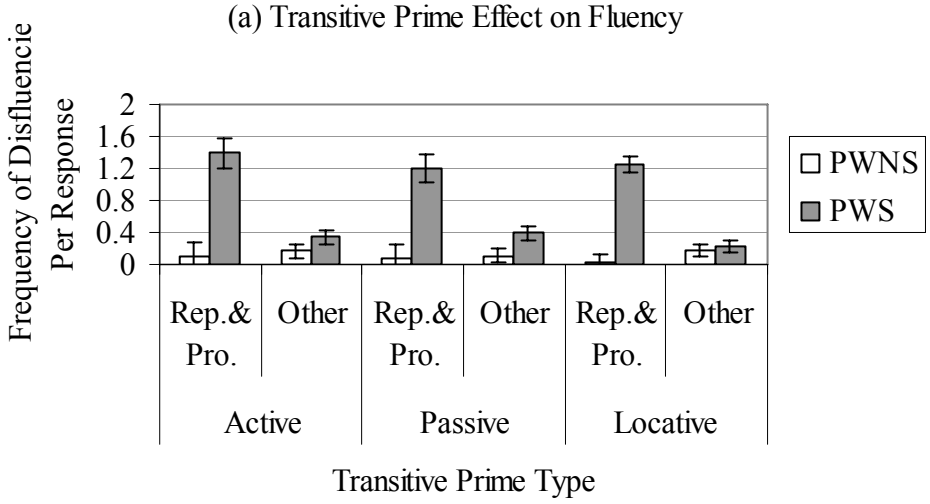
In summary, the results of the SRT analyses indicated that for all participants, SRTs for transitive responses were faster than those for dative responses and SRTs for dative responses were faster than those for two-clause responses.

To address the possibility that response length (in words) may have affected SRT across the three response types (i.e., Transitive, Dative, and Two-Clause) (See Figure 3-5 for the mean

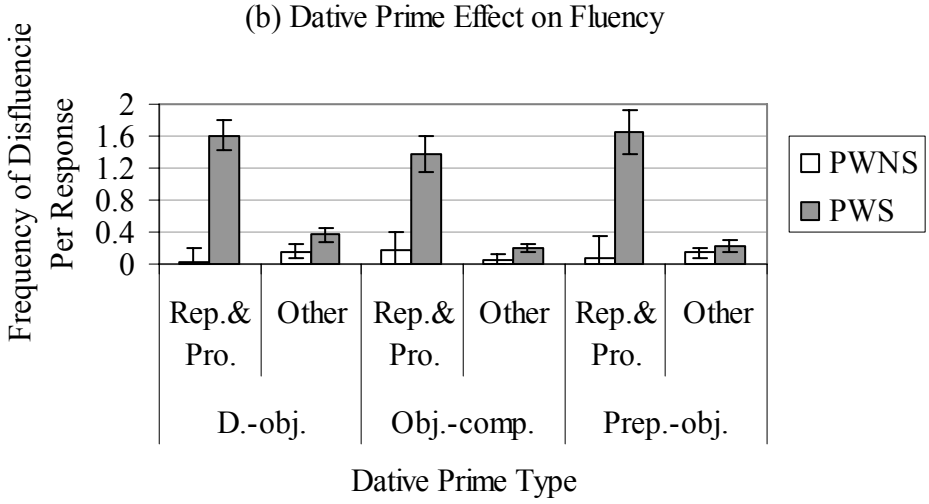
and standard deviation for utterance length (in words) in the responses produced across the three experiments), a 2 (Group) × 2 (Response Type) analysis of covariance (ANCOVA) was used. Group (PWNS, PWS) was the between- subjects factor, Response Type (transitive responses in the Transitive experiment, dative responses in the Dative experiment, and two-clause responses in the Two-Clause experiments) was the within-subjects factor, and Response Length (in words) was the covariate. The dependent variable was mean SRT for transitive, dative, and two-clause responses. As with the preceding analysis, this analysis included entirely fluent responses in addition to ones that had a fluent first noun phrase. The puerility assumption was tested but was not met (χ^2 (2) = 11.425, p = 0.003). Thus, the reported statistics are for the Huynh-Felt correction. There was no significant main effect for the within-subjects factor Response Type (F (1.64, 40.99) = 2.470, p = 0.107), no Response Type × Group interaction (F (1.64, 40.99) = 0.267, p = 0.723), no Response Type × Response Length interaction (F (1.64, 40.99) = 1.646, p = 0.208), and no main effect of the covariate Response Length (F (1,260) = 0.067, p = 0.798). Thus, for all participants, there were no differences in SRTs among the examined response types when differences in response length across experiments were considered.

Figure 3-1 Mean number and standard error for 'repetitions and prolongations' (Rep.& Pro.) and 'other' types of disfluencies (Other) in responses produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) when the priming sentences were (a) Transitive (Active, Locative, Passive), (b) Dative (Double-Object = D.- obj., Object-complement = Obj.-comp., Prepositional-object = Prep.-obj.), and (c) Two-Clause (Conjoined, Right-embedded = R-emb., Center-embedded = C.-emb.).

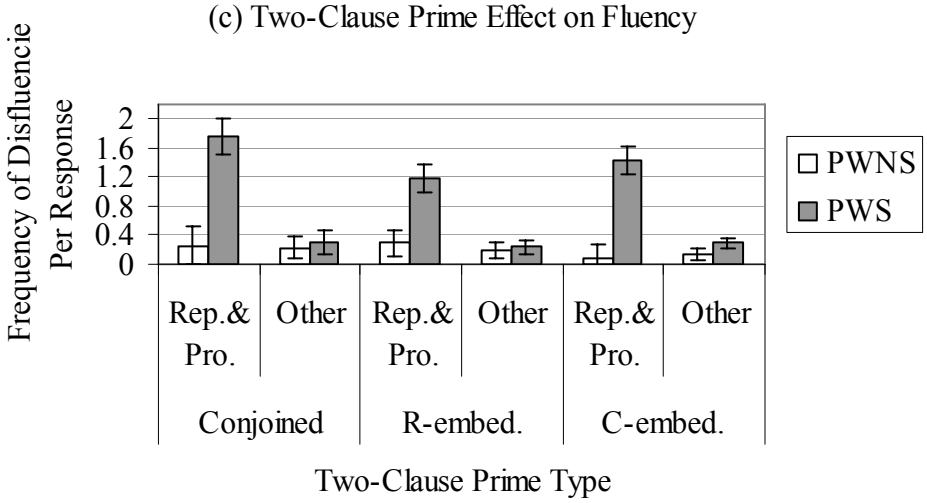
(a) Transitive Prime Effect on Fluency



(b) Dative Prime Effect on Fluency



(c) Two-Clause Prime Effect on Fluency



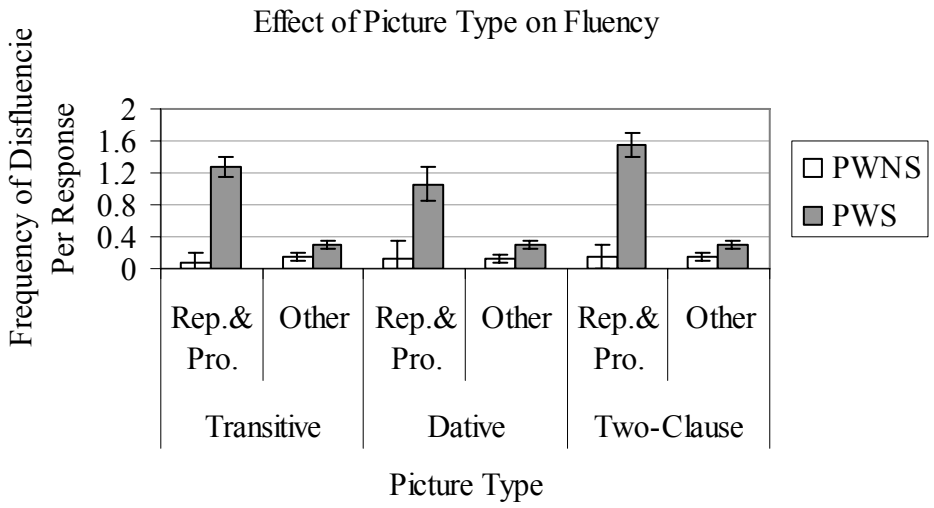
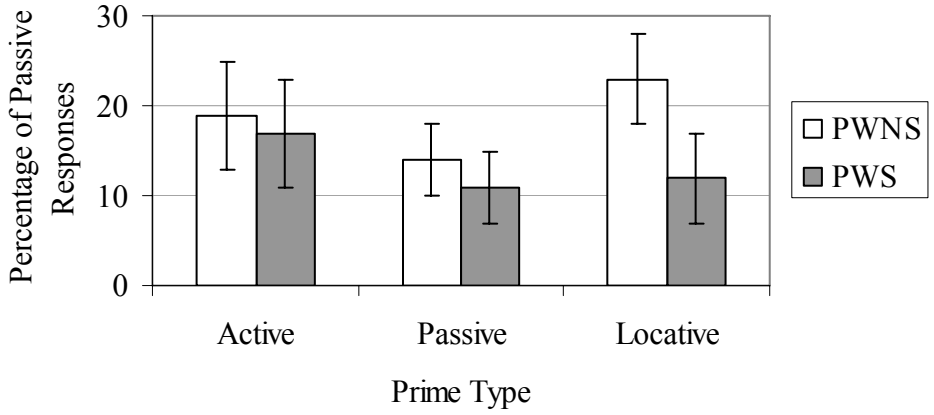


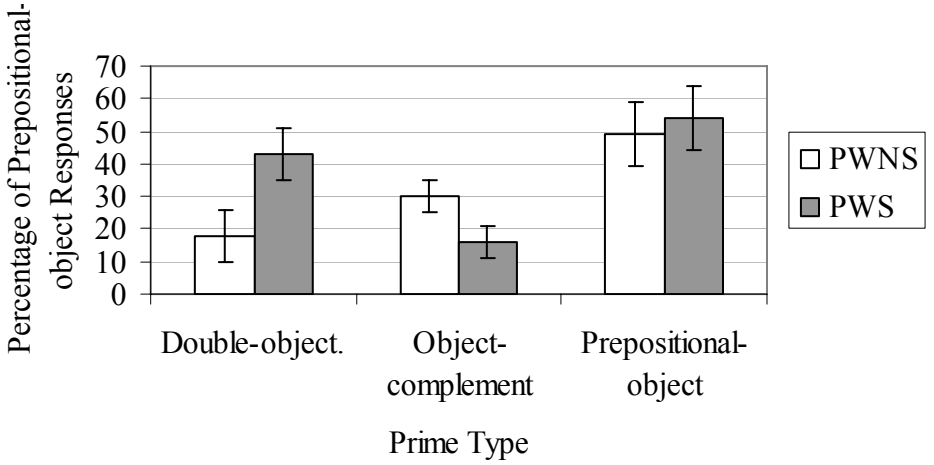
Figure 3-2. Mean number and standard error for 'repetitions and prolongations' (Rep.& Pro.) and 'other' types of disfluencies (Other) in responses produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) when the priming pictures were (a) Transitive (b) Dative, and (c) Two-Clause.

Figure 3-3. Mean percentage and standard error for responses produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) when the priming sentences were (a) Transitive (Active, Locative, Passive), (b) Dative (Double-Object, Object-complement, Prepositional-object), and (c) Two-Clause (Conjoined, Right-embedded, Center-embedded).

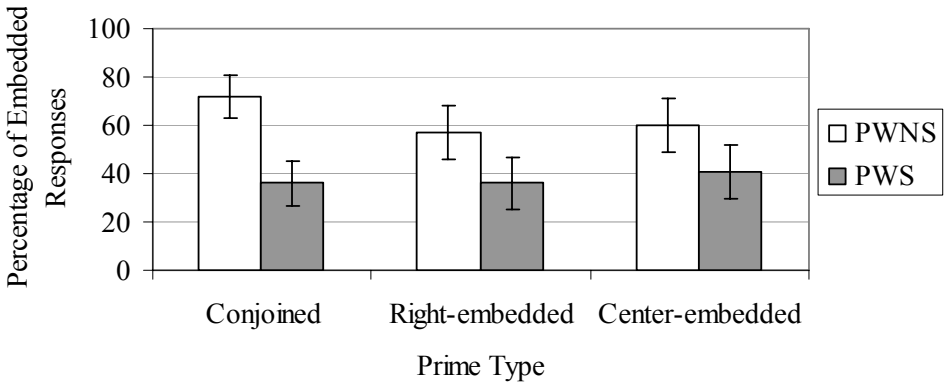
(a) Effect of Transitive Prime Type on Response



(b) Effect of Dative Prime Type on Response



(c) Effect of Two-Clause Prime Type on Response



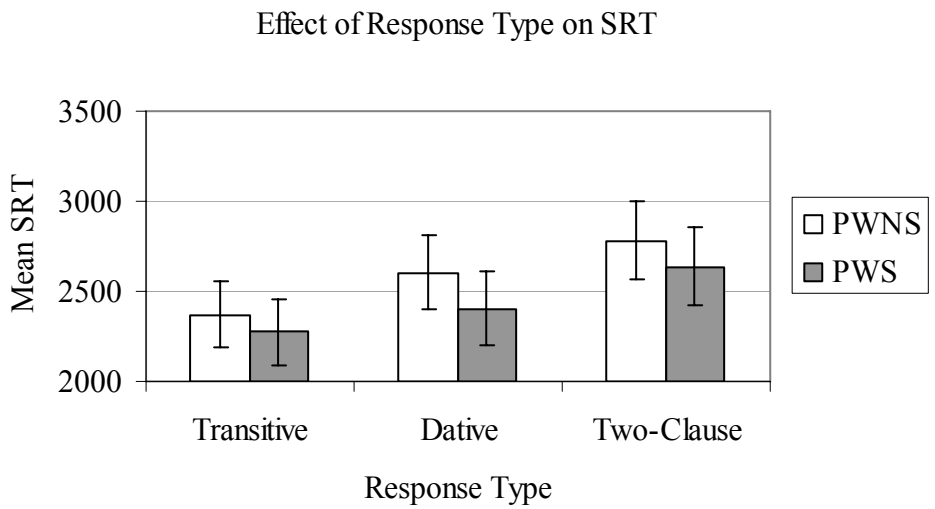


Figure 3-4 Mean and standard error for speech reaction time (SRT) for responses produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) when those responses were (a) Transitive in the Transitive experiment, (b) Dative in the Dative experiment, and (c) Two-Clause in the Two-Clause experiment.

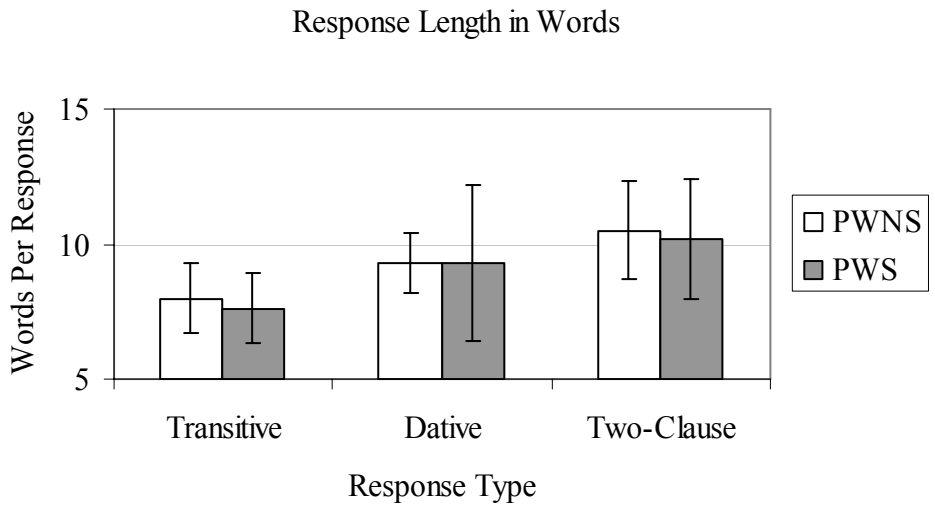


Figure 3-5 Mean and standard deviation for number of words produced by persons who do not stutter (PWNS; N = 14) and persons who stutter (PWS; N = 14) for (a) Transitive responses in the Transitive experiment, (b) Dative responses in the Dative experiment, and (c) Two-Clause responses in the Two-Clause experiment.

CHAPTER 4
DISCUSSION

Three main questions were asked in this study: (1) Does syntactic structure affect speech fluency in persons who stutter and persons who do not stutter? (2) Does syntactic structure affect speech reaction time in persons who stutter and persons who do not stutter? (3) Does syntactic priming affect speech reaction time in persons who stutter and persons who do not stutter? and (4) Does syntactic priming affect speech fluency in persons who stutter and persons who do not stutter?

These questions were motivated by theories which suggest a relationship between stuttering and difficulties in the retrieval and/or formulation of syntactic information during speech production. This study was designed to test these theories and to extend prior research by examining the relationship between syntactic structure, speech fluency, and speech reaction time in persons who stutter. Fourteen adults who stutter and fourteen adults who do not stutter participated in the study. Responses were elicited using a syntactic priming paradigm during which participants repeated sentences and then described pictures depicting actions that can be described using transitive, dative, and two-clause sentence forms. In this chapter, I remind the reader of the main study findings and discuss the general implications for those findings in light of previous research. Accordingly, the reminder of this chapter is designed as follows. In the first section, the results of the fluency analyses and the fluency in relation to priming are presented and discussed. In the second section, the results of the priming analyses are presented and discussed. In the third section, the results of the SRT analyses and the SRT in relation to response type are presented and discussed. In the fourth and final section, the limitations of the present study in addition to suggestions for future research are presented.

The Effect of Syntactic Structure on Fluency

Recall that in the present study, the purpose of using the above presented syntactic priming paradigm was to elicit responses reflecting a gradual increase in syntactic complexity. Namely, as defined in the present study, transitive sentences (i.e., active, locative, passive) reflected a low level of syntactic complexity, dative sentences (i.e., double-object, object-complement, prepositional-object) reflected an intermediate level of syntactic complexity, and two-clause sentences (i.e., conjoined, right-embedded, center-embedded) reflected a high level of syntactic complexity. The main finding from the fluency analyses indicated that although the PWS produced significantly more speech disfluencies than the PWNS, the syntactic structure (i.e., syntactic complexity) of the priming sentences used in the present study did not seem to affect fluency differently between the two study groups. This result is consistent with findings from previous studies that have examined the effect of syntactic complexity upon the speech fluency of adolescents and adults who stutter (e.g., Silverman and Ratner, 1997; Logan, 2001). This result, however, is not consistent with a number of previous findings from studies involving young children and adults who stutter. In those studies, results have pointed toward a significant relationship between the syntactic complexity of a sentence and the fluency with which it is spoken (e.g., Bernstein Ratner, 1997; Bosshardt, Ballmer, & De Nil, 2002; Logan and Conture, 1995).

It is interesting to consider the underlying factors for the difference in the effect of syntactic complexity on speech production between earlier reports indicating an effect in children who stutter and the results of the present study. One explanation pertains to the fact that almost all the research done with children who stutter to explore the effect of varying syntactic structure on speech production has examined this relationship in preschool and young school age children. As suggested in a number of previous studies (e.g., Silverman and Ratner, 1997; Logan,

2001, Yaruss, 1999), the syntactic structures used in experiments with younger speakers might be developmentally challenging to those children. For instance, complex syntax forms may take young children a relatively long time to retrieve or assemble and this in turn could place added stress on the speech motor system. An alternate possibility is that the children who stutter are prone to making excessive syntactic formulation during the sentence formulation process. Any such errors would seemingly have to occur prior to overt speech production, however, because children who stutter have not been found to produce substantially more syntactic errors in their spoken language than children who do not stutter. In any case, it is logical to assume that with age and increased competency in one's native language, what might have been considered a challenging linguistic form for a younger age group might not pose much challenge in adolescence or adulthood. Along the same lines and within the framework of earlier presented models of stuttering (e.g., the Demands and Capacities Model), increased syntactic complexity could be more demanding on children's speech and language systems (as compared to adults) and thus, increased percentage of speech disfluency in responses produced by children who stutter could be viewed as resulting from inability of their language (and probably speech) systems to handle such demands during ongoing speech. As Yaruss (1999) suggested, longer and/or more syntactically complex sentences contain more information units than shorter and less syntactically complex sentences. When processing the more syntactically complex sentence structures, more such information units may need to be held in short-term memory until decisions about the target utterance are made. As Yaruss explained, this in turn might exert more demands on the processing system resulting in a higher percentage of disfluencies in the more syntactically complex responses than in the less syntactically complex ones. Thus, it is

reasonable to suggest that from a developmental point of view, it is not surprising that syntactic structures that have been reported as challenging to children are not as challenging to adults.

Although syntactactic complexity does not appear to affect overt fluency in AWS, it does seem to affect other types of functions. For example, Bosshardt et al. (2002) reported that when speakers in their study (i.e., adults who stutter and adults who do not stutter) were asked to generate and produce sentences during a single-task (using two given nouns to generate a sentence) versus dual-task paradigm (using two given nouns to generate a sentence and at the same time decide if the two nouns are in the same noun category or if they rhyme) both adults who do and do not stutter exhibited a reduced percentage of accurate rhyming and category decisions. In addition, persons who stutter produced significantly fewer propositions (i.e., a predicate and its argument(s)) under the dual-task than persons who do not stutter. The results were taken to indicate a "vulnerability" in the speech- production systems of persons who stutter which is observed during "attention-demanding" tasks such as the secondary rhyme and category decision tasks used in that study. Similarly, Cuadrado et al. (2003) reported both neural-processing and response accuracy differences between persons who stutter and persons who do not stutter during online grammaticality judgment tasks. Specifically, and when asked to decide online (i.e., decide during or immediately following a response) whether the verbs in a syntactically simple versus a syntactically complex sentence indicted a grammaticality agreement, the percentage of accurate grammaticality judgments for persons who stutter was significantly lower than for participants who do not stutter for grammaticality violations that occurred in the more syntactically complex sentences. The results of the grammaticality judgment task in addition to results of ERP measures collected during those tasks were taken by

Cuadrado et al. (2003) to indicate that "neural mechanisms reflecting postlexical analysis, specifically for syntactic reanalysis, operate differently in (PWS)) (p.974).

It is worth mentioning that the study tasks in Bosshardt et al. (2002) involved generation and production of the responses while in Cuadrado et al. (2003) no speech production was involved required. Thus under tasks that are considered more demanding and even in the absence of speech production, persons who stutter seem to exhibit difficulties in sentence planning and production than persons who do not stutter. Thus, in summary, it seems that results of studies examining overt speech fluency (e.g., frequency of disfluencies per response in relation to certain syntactic forms) have shown a comparable performance between the PWS and the PWNS on the syntactic tasks used in those studies. On the other hand, studies of more subtle aspects of linguistic performance (e.g., those studies examining syntactic processing during sentence generation through ERP examination) have shown an difference between persons who stutter and persons who do not stutter.

The syntactic priming paradigm used in the present study could be viewed as more challenging than mere repetition of given utterances because of the fact that it necessitates that a participant generates a novel sentence instead of repeating the sentence he or she just heard (as opposite to the data elicitation paradigm used in Logan (2003) study viewed above). In addition, the paradigm used in the present study employed a recognition memory task which required the participants to indicate whether or not they heard or saw the target sentences before within the framework of the experiment and which served as a secondary or concurrent task. Based on these two characteristics of the priming paradigm used, and although no significant effect of syntactic structure was observed in the present study, I believe that the syntactic priming task used in the present study elicited sentences was in some ways closer to what a speaker might produce in

everyday speaking contexts in that they required that a speaker to "creatively" produce a sentence rather than merely produce a sentence they had just heard or read, as was the case in studies by Silverman and Ratner (1997) and Logan (2001). Accordingly, the results of the present study could be viewed as an addition to the increasing body of literature that argues against a role for syntactic complexity – independent of whatever effect that syntax may have upon utterance length – in the frequency with which adults who stutter produce overt disfluency.

Two other findings for the fluency analyses reported in the present study pertain to the frequency and type of speech disfluencies produced (i.e., 'repetitions and prolongations' versus 'other' types of disfluencies). The first finding indicated that overall, the PWS produced significantly more 'repetitions and prolongations' per response than the PWNS. This finding is not surprising based on the fact that (a) 'repetitions and prolongations' are considered central or core behaviors in stuttering (see Bloodstein, 1995 for a detailed description), and (b) group selection criterion were based on, among other considerations, the frequency with which participants produced these types of disfluency in connected speech. The second finding indicated that participants in the two study groups produced a comparable number of 'other' types of disfluencies per response across the examined sentence types. This finding is consistent with results from other studies that have compared the frequency of this disfluency class between speaker who do and do not stutter. The overlap in frequency with which speakers from both groups produced 'other' disfluencies such as interjections and revisions in could reflect general similarities between the two groups in (a) speech processing mechanisms, or (b) general language formulation aptitude (e.g., lexical selection, syntactic formulation). Earlier studies have shown that such disfluencies are common in typical speakers (see Bailey and Ferreira, 2003 for a review) and, leaving aside instances when speakers who stutter use interjections and revision as a

strategy for concealing ‘repetitions and prolongations’ from listeners, seem to be peripheral to the fundamental impairment that characterizes development stuttering.

Another nonsignificant finding related to the fluency analyses warrants some discussion. In the present study, PWNS produced a comparable number ‘repetitions and prolongations’ and ‘other’ disfluencies in most of the experimental conditions. This finding was somewhat unexpected because previous research on conversational fluency in PWNS has found that they produce roughly twice as many ‘other’ disfluencies as they do ‘repetitions and prolongations’ (Bloodstein, 1995). Thus, this disfluency pattern for the PWNS suggests that sentence production tasks used in the present were somewhat challenging for the PWNS.

The Effect of Picture Type on Fluency

As you may recall, all participants in the present study produced significantly more disfluencies in responses following the two-clause primes than in responses following the transitive primes. This finding is consistent with the results of Silverman and Ratner’s (1997) study which reported an increase in the number of normal disfluencies (e.g., interjections and revisions) by adolescents who stutter and adolescents who do not stutter (ages 10-18 years) (although in the present study, the reported significant increase was overall, i.e., for all types of disfluencies regardless of whether they were ‘repetitions and prolongations’ or ‘other’ types of disfluencies). In the Silverman et al. (1997) study, the significant increase in ‘other’ types of disfluencies was observed in center-embedded responses (or structures defined in that study as being “hardest” in terms of syntactic complexity) when compared to questions (defined as being “easiest” in terms of syntactic complexity) and when compared to right-embedded responses (defined as being “moderate” in terms of syntactic complexity). The authors also reported the frequency of repetitions and prolongations (or as defined in that study “stuttered disfluencies”) was not significantly affected by syntactic complexity. In the present study, and as described on

the previous chapter, the frequency of both ‘repetitions and prolongations’ and ‘other’ types of disfluencies seemed to significantly increase under conditions of increases syntactic complexity.

As explained in the Methods chapter, the transitive sentences and pictures used in the present study each include two arguments (an agent and a patient). The dative sentences and pictures on the other hand include three arguments (an agent, a direct patient, and a second indirect patient). The two-clause sentences and pictures include four arguments (an agent and a patient in the main clause, and an agent and a patient in the embedded clause or in the second independent clause in the case of the conjoined primes). It can be argued that the more arguments a response includes, the more complex that response is in terms of the computational resources involved in generating such a response under time constraints similar to the ones used in the present study. In terms of differences in frequency of disfluencies between the two-clause and transitive responses examined in the present study, it is reasonable to suggest that the two-clause responses impose greater memory loads than that imposed by the generation of transitive and dative sentence forms. These memory loads might result from the fact that when generating right-embedded responses as in “The woman pulled the man who pulled the dog,” one ‘agent’ has to be held in memory and when generating center-embedded responses as in “The woman who pulled the man pulled the dog” two agents have to be held in memory to be matched with their verbs.

The Effect of Syntactic Structure on Speech Reaction Time

Recall than in the only study that examined SRT in adults who stutter in relation to syntactic complexity (i.e., Logan, 2003), the author reported that SRT was significantly longer for the PWS than the nonstuttering controls for three of the four sentence types used in that study. The first finding in the present study was that the overall SRT values for PWS were on average 70.42 ms shorter than the overall SRT for PWNS (mean SRT for PWNS = 2667.20 ms

and for PWS = 2596.78 ms). This result is inconsistent with earlier findings which reported that the overall mean SRTs for the PWS were longer (by approximately 132 ms) than SRTs for PWNS (Logan, 2003) for the linguistic stimuli used in that study. This finding is also inconsistent with previous findings indicating that the PWS tend to take more time than PWNS to initiate vocal responses to non linguistic stimuli (see review in Logan, 2003). It is not possible to definitely determine why the present findings are inconsistent with those previous findings. It is possible that although the participant selection procedures used in the present study were designed to ensure random selection, the group that actually participated might represent a subgroup of persons who stutter whose speech production processes are not as affected by linguistic and motoric planning demands as reported for participants in the earlier referenced studies. A number of earlier investigations have implied that speakers who stutter are a heterogeneous group and that generalizations about stuttering behaviors might not always valid for all persons who stutter (Bloodstein, 1995). For example, Logan (2003) reported that not all participants who stutter in his study exhibited longer SRTs compared to participants who did not stutter. Thus, it reasonable to suggest that perhaps including many more participants in similar future investigations might ensure a better representation of the population of speakers who stutter and subsequently provide more details about the effect of both time constraints and syntactic complexity on speech reaction time in those speakers.

The second finding of the SRT analyses in the present study indicated that for all participants and when examining responses in which the first noun phrase was fluent, SRTs for transitive response were significantly shorter than SRTs for dative responses which in turn were significantly shorter than those for two-clause responses. However, when response length was

controlled (i.e., covaried) across experiments, the difference in SRT between the response types was no longer observed.

Although the finding pertaining to no differences between the two groups in speech reaction time seems inconsistent with that reported in Logan (2003), the difference between the reported results of the present study and Logan (2003) study could be attributed to a number of factors. First, in his preparation of the study material, Logan elected to increase the syntactic complexity of an utterance by generating sentences that differed in the elaboration of the subject noun phrase prior the main verb in a given sentence. For example, two of the sentence forms used by Logan (2003) were of (a) a Determiner + Adjective + Adjective + Noun as in "The long and shiny car belongs to the girl" and (b) a Determiner + Noun + Relative Clause as in "The car belongs to the girl who plays soccer." The structure of sentence form (a) employs pre-noun modification (i.e., Determiner + Adjective + Adjective), while the structure of sentence form (b) employs both pre and post noun modification (i.e., Determiner-pre, Relative Clause-post). As mentioned above, Logan reported a significant difference between the two study groups in mean SRT for three of the four sentence forms used in the study (among which are SRTs for responses reflecting the structures of sentence forms (a) and (b) above). In the present study, the increase in syntactic complexity was defined in terms of (a) the number of arguments described within a given utterance, and (b) the number of independent and dependent clauses within that utterance. In terms of the number of arguments within each sentence type, the transitive sentences included two arguments, dative sentences included three arguments, and two-clause sentences included four arguments. In terms of the number of independent and dependent clauses within each sentence type, both transitive and dative sentences included only one independent clause and no dependent clause, while the two-clause sentences included one independent and one dependent

clause. As explained in the Introduction and Methods chapters of the present study, earlier studies have suggested that the more arguments a sentence includes the more challenging that sentence is (see Shapiro, 1997 for an overview). The results of the SRT analyses in the present study indicating an increase in SRT as the syntactic (and thematic or semantic) complexity of the response increased seem to support these suggestions.

Although, as mentioned above, increased elaborations of the noun phrases (and in turn of response length) within an utterance have been shown in earlier studies to affect speech reaction times in both typical speakers and speakers who stutter (Ferreira, 1991; Logan, 2003) such elaborations were not factored into sentence preparation in the present study. Recall that when response length was controlled in the analyses, the difference in SRT between the response types was no longer observed in the present study. Based on this finding, it could be argued that although response length has been shown in previous studies to affect SRT, the effect of syntactic structure cannot be ruled out as a contributing factor to differences in SRTs between response types. It can be suggested that future research employing the syntactic priming methodology could adopt alternative ways in defining the syntactic complexity such as combining the definition of complexity used in the present study (i.e., the number of elements within a given sentence in addition to number of independent and dependent clauses) and that used by Ferreira (1991) and Logan (2003) (i.e., elaboration of noun-phrase elements within the target utterance, thus increasing response length). Adopting this definition within the framework of a syntactic priming paradigm might assist in providing additional views of any interactions between increased syntactic complexity (and increased utterance length) on speech timing in both speakers who do not stutter and speakers who stutter.

Two methodological points need to be considered when talking about the SRT analyses reported in the present study. First, although I argue above that the syntactic priming paradigm used in the present study involved generation of novel sentences by the participants, one could not rule out the fact that the responses are not entirely novel. This is based on the fact that studies employing this paradigm have consistently reported a tendency for participants to use many of the structures in the priming sentences when they produce a response. Thus, for all responses produced in the present study, a 'model' was always available to reuse. This in turn might have reduced the time needed by all participants to generate the utterances and thus eliminated any group differences that might have been observed had the structures in the target sentences been truly novel. One way to overcome this could be by introducing a 'no prime' condition to the priming study material. For example, instead of all the responses being preceded by a priming sentence, some of target responses could be preceded by a 'no-prime' condition. In this case, participants would have to generate, on their own and without the convenience of the modeled structure in the priming sentence, a novel sentence structure and use it to describe that picture. In this case, one could argue that differences between adults who stutter and adults who do not stutter in initiating their sentences might be more pronounced. (Of course, this approach contains one major drawback – the inability to control for response type and response length.). Nonetheless, the argument builds on the hypothesis that when asked to perform a reasonably demanding task (such as one involving the generation and production of a response under time pressure), subtle differences between the language and speech processing systems in persons who stutter versus persons who do not stutter are observable when performing such a task. Indeed, studies that have reported a difference in SRT between persons who stutter and persons who do not stutter have shown no significant difference between the groups in SRT when a

prime was provided (similar to the report in the present study); however, such differences were significant in the absence of a prime (e.g., Anderson and Conture, 2003).

Concerning the second methodological point (i.e., Data elicitation procedures and instructions) recall that in the present study, and prior to the presentation of the study material (i.e., priming pictures), participants were instructed to think of and say a sentence describing the given pictures as soon as it appears on the computer screen. This instruction was given before any material presentation and was only presented once to each participant. Recall also that on average, the study task took about 45-60 minutes to finish. The participants were not reminded of that instruction anytime during the time course of material presentation. This was done to be true to the methodological procedures used by Bock and colleagues in their priming studies and thus be able to compare the results of the present study to the results of those priming studies. On the other hand, in the previous studies that have reported an effect of syntactic structure on SRT (i.e., Logan, 2003), participants were specifically instructed and frequently reminded to initiate their responses as fast as they could upon the presentation of an auditory cue (i.e., sound signal). It could be argued that the instructions in Logan's study might be more likely to elicit between groups differences in SRT than those used in the present study and that could be due to the fact that time constraint was not given a central role in that participants were not instructed to respond 'as fast as they can' and thus they might have taken their time to initiate their responses. This in turn may have eliminated any group differences and thus resulted in not observing any differences in SRT between groups in the present study. One suggestion for future research examining SRT using the priming methodology with persons who stutter is to specifically instruct the participants to initiate speech as fast as they can, and perhaps, even add reminders to do that at different times during the time course of material presentation. This in turn might add

to the time pressure and provide addition information about how participants may behave under both syntactic priming conditions and under continuous time pressure.

The Effect of Syntactic Priming on Response Type

The priming analyses in the present study yielded several findings. The first finding suggested that priming methodology in general and syntactic priming in specific can be used to elicit responses reflecting a variety of syntactic structures, including structures that are less frequently observed such as datives and passives. This result was expected and is consistent with earlier results with both typical speakers (e.g., Bock, 1986; Bock & Loebell, 1990; Smith & Wheeldon, 2001) and with speakers who stutter (Anderson & Conture, 2004; Burger & Wijnen, 1999; Hartfield & Conture, 2006; Melnick, Conture, & Ohde, 2003; Pellowski & Conture, 2005; Wijnen & Boers, 1994). As the reader may recall, the study material used in the present study was adapted from material that was developed and has been used by Bock and colleagues for almost twenty years. The sentence structures used in the present study were also ones that previous syntactic priming studies have consistently reported to exhibit a priming effect. Thus, it was not surprising that participants in the present study showed response patterns that were similar to those reported in the above listed studies (e.g., Bock, 1986; Bock & Leobell, 1990) to reuse the structure of the priming sentences in their responses.

Another finding for the priming analyses reported in the present study indicated that for two of the three structures examined in the present study (i.e., transitive and two-clause structures), participants in the two study groups did not show significant differences in the priming effect. This result is not consistent with the only study that has examined the syntactic priming effect in persons who stutter. Specifically, Anderson and Conture (2004) reported that children who stutter seem to exhibit a great syntactic priming effect than children who do not stutter. The authors argued that children who stutter might be “less skilled in morphosyntactic

construction processes" (p. 564) than children who do not stutter. This in turn might affect the efficiency by which they express an intended message because these children might have fewer computational resources available for syntactic processing. Within this view, children who stutter might benefit from syntactic priming because they might take advantage of previously activated forms (i.e., those of the priming sentences) to more effectively generate the intended syntactic forms which in turn might reduce the time as observed in shorter SRTs for the primed sentences in that group. As mentioned above, the results of the present study did not show a difference in the extent of priming effect in the two groups. The differences between the results reported in the present study and those reported by Anderson and Conture (2004) might be attributed to one main reason. Namely, studies examining syntactic processing abilities in adults who stutter have consistently shown that although syntax might play a role in stuttering during the childhood years (e.g., Bernstein Ratner and Sih, 1987; Gaines, Runyan, & Meyers, 1991; Gordon, Luper, & Peterson, 1981; Logan & Conture, 1995; 1997; Wall, Starkweather, & Cairns, 1981; Yaruss, 1999) it might not be the main contributing factor to stuttering during adolescence and adulthood (e.g., Silverman and Ratner, 1997; Logan, 2001; 2003). The authors of the later group of studies suggested that although some syntactic structures continue to be challenging for both adolescents and adults who do not stutter, the effect of syntax in general and syntactic complexity in specific seems to decrease as speakers grow older and their linguistic competency improves. Within this view, it could be argued that children who stutter may exhibit subtle speech production deficits and the presence of a prime in the context preceding the production of given structures may provide a 'priming boost' and thus assist in overcoming either the retrieval or encoding difficulties that might underlie speech production in those children. Adults who stutter on the other hand have a higher linguistic competency than children who stutter as a result

of ‘language maturation process’, and thus priming (syntactic priming in this case) might not play as prominent a role during speech processing as it would in children resulting in a smaller gain of syntactic priming similar to the reported in the present study.

In terms of the effect of specific syntactic primes on frequency of syntactic structures in responses, the results of the present study indicated that the structure of some syntactic primes did affect the probability of the participant reusing the structure in those primes. The following section presents the findings for the transitive, dative, and two-clause priming structures used in the present study and discusses these results in comparison with earlier findings.

The first finding from the transitive priming experiment indicated that for all participants, the structure of the transitive priming sentence did not seem to significantly affect the frequency with which participants produced passive responses. Specifically, for all participants 18% of the responses following passive primes were passive, 18% following active primes were passive, and 13% following locative primes were passive. In addition, and as can be observed from these percentages, the frequency of passive responses following locative primes was lower than that following both passive and active primes. These findings seem inconsistent with the ones reported by Altmann et al. (2006) and Bock et al. (1990) who reported an overall significant increase in passive responses after passive primes in both older and younger speakers. The findings also seem inconsistent with those reported by Bock et al. (1990) who suggested that the exposure to locative primes significantly increases the probability of reusing a passive prime in the response. As the reader may recall, half the participants in the present study were college age (7 out of 14 participants). Altmann et al. (2006) had explained that participants in Bock et al’s study might have produced an overall high proportion of passive responses and passive responses following both passive and locative primes because those participants were college

age, and may have experienced frequent exposure to passive structures in lectures, thus making those structures more familiar to those participants and resulting in a higher probability of using those passive structures in their responses. Still, in the present study, the exposure to passive and locative primes did not seem to significantly increase the probability of reusing a passive structure in the response for the participants overall. It could be argued that the number of participants in the Bock et al. study was much higher than that in the present study and thus might have resulted in a more sensitive examination of the transitive primes in those studies. One suggestion for future research would be to include many more participants and thus increase the sensitivity of the study procedures to capture any effect the transitive primes may have on the production of passives.

Different from the results of the transitive prime experiment, two significant findings were reported in the dative prime experiment. The first finding indicated that overall, participants produced significantly more prepositional-object responses following prepositional-object primes than following double-object or object-complement primes. The second result indicated that participants in the two study groups exhibited a different pattern in terms of the structure of the sentences they produced following the examined dative primes. Specifically, the PWS produced significantly more prepositional-object responses following double-object primes (43%) than following object-complement primes (16%). The PWNS on the other hand exhibited the opposite pattern producing more prepositional-object responses following object-complement primes (30%) than following double-object primes (18%). The difference in the structure of the dative response for the PWNS was not statistically significant. It is interesting to speculate what factors might underlie the difference in the frequency of prepositional-responses between the two groups. Recall that the dative primes which the participants repeated in the present study

exhibited three structures. The first dative prime was that of a double-object dative verb as in 'The actress sold the stage manager her jewelry.' The second dative prime was that of a prepositional-object dative verb such as in 'The actress sold her jewelry to the stage manager.' The third prime used in the dative experiment was that of an object-complement verb as in 'The stage manager nominated Mary best actress.' The sentences associated with the first two dative verb forms (i.e., double-object and prepositional-object) share a common semantic representation or theme in that both dative sentences include an agent (e.g., Mary), and two objects (e.g., boy and paintbrush). The double-object and object-complement primes on the other hand share the surface noun phrase structure, in that they both have a first noun phrase, followed by a verb, which in turn is followed by two noun phrases. When participants are exposed to one of the above described dative primes, and if priming is driven by the thematic aspects of the primes, one would expect a comparable frequency of prepositional-object responses following both prepositional-object primes and double-object primes. However, if priming is driven by the structural aspects of the primes, one would expect a comparable frequency of prepositional-object responses following both prepositional-object and object-complement primes. As reported earlier in this chapter and in the Results chapter, the PWS produced most prepositional-object responses following prepositional-object and double-object primes, thus, it could be argued that perhaps, priming of dative sentence forms in the PWS group is more driven by the semantic aspects of the response rather than the structural aspect. On the other hand, the PWNS in the present study produced more prepositional-object responses following prepositional-object primes and a comparable number following object-complement primes. Based on the above, it could be argued that perhaps, priming dative sentence forms in the PWNS group is more driven

by the structural aspects of the available options and in the PWS is more driven by the thematic aspects of the available options.

The results of the two-clause prime experiment were similar to those of the transitive prime experiment and provided one main finding. Specifically, and for all participants, the structure of the two-clause priming sentence did not seem to significantly affect the frequency by which participants produced embedded responses. Specifically, and although participants in the two study groups exhibited a tendency to produce two-clause responses following two-clause primes, the presence of the two-clause prime did not significantly increase the probability of using the structure of that prime in the response. In terms of frequency of embedded responses following the examined two-clause primes, 54% of the responses following conjoined primes were embedded, 46% following center-embedded were embedded, and 51% following right-embedded primes were embedded. This finding is consistent with the one reported by Altmann et al. (2006) who reported that the structure of the "complex" (i.e., two-clause) priming sentence did not seem significantly to affect the frequency by which older speakers produced embedded responses.

Differences Between The Two Groups On the Prestudy Tasks

Recall that all participants in the present study finished a number of language and memory tasks as part of the participant screening procedures. The tasks were digits forward, digits backward, digit ordering, and WAIS vocabulary test. The results of the statistical analyses comparing the means of the two groups on those tasks indicated significant differences between the two groups on two of those four tests. Namely, the mean scores for the PWNS were significantly higher on the WAIS vocabulary and the digit ordering tests. Although differences on these tests had the potential of confounding any potential differences between the groups on of several of the analyses conducted in the present study, the responses of participants in the two

study groups were comparable on the majority of the examined measures and thus, did not seem to be affected by the factors driving the differences on the tasks described above. Additionally, it appears that whatever role memory would play in study tasks similar to the ones used in the present study, and based on the fact that there were not significant differences between groups on those study tasks, it is reasonable to suggest that the role memory plays in those tasks might not be strong enough to significantly affect speech production. It is interesting to speculate what may have driven those differences in scores on the prestudy language and memory tasks. One suggestion for the difference in scores on those tests could be based on a common issue in stuttering research. Namely, many of the persons who stutter who volunteer to participate in stuttering research come from a population representing a broad range of socioeconomic and educational background. The control group on the other hand might in many cases (one of which is the present study) represent a narrower range of the population (i.e., college age range) and thus reflect less diversity in that regard than the other group. Although most of the participants in the present study were matched on as many factors as possible, still, it could be argued that the PWS did represent a broader group while the PWNS represented a diverse group.

Conclusion

In the present study, the syntactic priming methodology was used to examine the effect of syntactic structure on speech fluency and speech timing in adults who do and do not stutter. The results suggest that although there were some differences between the study groups in processing certain sentence types (i.e., datives) overall, syntactic processes involved in speech planning in persons who stutter might be performed in a manner similar to those processes in persons who do not stutter. This suggestion is based on the findings that speech initiation times and speech fluency were similarly affected in participants in the two study groups by the structure of the sentences produced by those participants. The present study is one of only few studies that have

used the syntactic priming methodology to examine speech production processes in adults who stutter. The results support findings from a number of previous studies and show that syntactic priming is a feasible methodology to study sentence processing abilities in persons who stutter. In addition, and because participants tended to produce a variety of structures in their responses, this methodology could assist in examining the effect of infrequent syntactic structures such as passives and datives on speech production in persons who stutter.

APPENDIX A
PRESTUDY TESTS

Background Survey: Control Group

Participant ID _____ Today's Date _____

DESCRIPTION OF SPEECH AND LANGUAGE:

1. Have you ever had or currently have difficulty with:

1a. Speech? Yes ____ No ____. If "yes", please describe.

_____

1b. Oral or written language? Yes ___ No ____. If "yes", please describe.

_____

1c. Fine or gross motor coordination? Yes____ No _____. If "yes", please describe.

_____

2. Do you feel you hear normally? Yes ____ No ____. If "no", please describe.

   _____

3. Do you have difficulty remembering things? Yes ____ No ____, if "yes", please describe.

   _____

4. Do you feel that you have normal vision? Yes ____ No ____.
5. How would you describe your current health?

   Excellent ____ Good ____ Fair ____ Poor ____

6. Are you currently taking any medication? Yes ____ No ____. If "yes" please describe.

   _____

7. Does the medication affect your communication?

   _____

ACADEMIC EDUCATIONAL (skip (a) if not currently attending school)

1. Do you currently attend school? Yes ____ No ____ (if "no" skip to (b))
   a. Name of school: _____
   b. Year in school: _____
   c. Major area of study: _____
   d. Highest degree earned: _____

Background Survey: Experimental Group

Participant ID _____ Today's Date _____

DESCRIPTION OF SPEECH AND LANGUAGE:

1. Have you ever had or currently have difficulty with speech? Yes ____ No ____. If yes, please describe.

   _____

   _____

   _____

2. At what age was your problem first noticed? _____
3. Who noticed the problem? _____
4. How has the problem changed since that time? _____

   _____

   _____

5. Do other people notice your speech problem? _____
6. What do you believe caused the problem? _____
7. Have you previously had your speech, language, hearing skills evaluated?

   Yes ____ No ____. If "yes", please provide details. _____

   _____

   _____

8. Have you even had speech or language therapy? Yes ____ No ____. If "yes":

   Where: _____

   With whom: _____

   Dates: _____

   Focus: _____

   Results: _____

9. Are you currently applying any strategies that you may have learned during speech or language therapy? Yes ____ No ____. If "yes" please describe.

   _____

   _____

10. Have you ever had or currently have problems with written language?

    Yes ____ No ____. If "yes", please describe. _____

    _____

11. Have you ever had problems with fine or gross motor coordination?

    Yes ____ No ____. If "yes", please describe. _____

    _____

12. Do you feel you hear normally? Yes ____ No ____. If "no", please describe.

    _____

13. Do you feel that you have normal vision? Yes ____ No ____. If "no", please describe.

    _____

14. Do you have difficulty remembering things? Yes ____ No ____, if "yes", please describe.

    _____

15. Do any of your close family members have a history of speech, language, hearing, or neurological problems? Yes ____ No ____. If "yes" please explain.

    _____

    _____

16. How would you describe your current health?

    Excellent ____ Good ____ Fair ____ Poor ____

17. Are you currently taking any medication? Yes ____ No ____. If "yes" please describe.

    _____

18. Does the medication affect your communication? _____

ACADEMIC EDUCATIONAL

19. Do you currently attend school? Yes ____ No ____ (if no kip to (b))

    e. Name of school: _____

    f. Year in school: _____

    g. Major area of study: _____

    h. Highest degree earned: _____

Pre-study Tests Used with Participants Who Stutter

Self-Rating Scale

Participant ID# _____ Today's Date _____

Please respond to each of the following statements by circling the point along the seven-point scale that corresponds to your impressions of your speech. If a particular item does not pertain to you, please write "not applicable" in the margin.

1. I participate in group-discussions with friends.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

2. I participate in group-discussions with family.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

3. I participate in group-discussions during class or at work.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

4. I stutter when talking with family members.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

5. I enjoy talking with others.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

6. My muscles feel tense when I speak.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

7. I feel out of breath when I am speaking.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

8. Stuttering limits my academic and/or professional performance.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

9. I enjoy speaking before groups of people.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

10. I stutter when talking with friends.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

11. I feel embarrassed by the way I talk.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

12. I feel nervous when I am speaking to adults.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

13. Stuttering limits my ability to communicate with teachers and/or employees.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

14. Stuttering limits my ability to communicate with friends.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

15. I repeat sounds or syllables when I am talking.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

16. If I expect to stutter on a certain word, I will substitute another word in its place.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

17. I become "blocked" on speech sounds when I am talking.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

18. I avoid speaking with others because of my stuttering.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

19. When talking with others, I acknowledge the fact that I stutter.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

20. My academic skills are better than average.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

21. I think that, someday, I will be able to manage my stuttering.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

22. I do whatever is necessary to hide my stuttering from others.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

23. I feel discouraged about the way I talk.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

24. Other people react negatively to my stuttering.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5 ---------- 6 ----------7

Always Sometimes Never

Comments: _____

_____

_____

Participant ID# ______________ Date ______________ Severity Level ______________

Stuttering Severity Task

I want you to talk for 3 minutes about a movie you saw.

I want you to talk for 3 minutes about a pleasant experience.

Mean duration of three longest disfluencies: ____

Concomitants: ____

Number of disfluencies in 600 syllables: _____; % of disfluencies in 100 syllables: ______

Suggested severity level: ____

Comments: ____

APPENDIX B
PRIMING AND FILLER SENTENCES AND PICTURES

Active/Passive/Locative

LIST A

Active

The students were bankrupted by the new sports complex.
The tourist was confused by the blinking traffic light.
The 747 was alerted by the airport's control tower.
The businessman was paged by the airline ticket agent.
The scientist was inspired by the apple tree.
The minister was cut by the broken stained glass window.

Passive

The cub scouts enjoyed the camp fire.
The construction worker drove the bulldozer.
The missing geologist underestimated the volcano.
The secretary cleaned the drinking fountain.
The quarterback destroyed the jukebox in the bar.
The surfer watched the stormy sea.

Locative

The stockbroker was sitting by the client.
The woman was swimming by the jellyfish.
The lumberjack was eating by the giant redwood tree.
The dog was barking by the fence.
The councilman was strolling by the new building.
The ship was docking by the pier.

LIST B

Active

The stockbroker impressed the client.
The woman caught the jellyfish.
The lumberjack struck the giant redwood tree.
The dog jumped the fence.
The councilman opened the new building.
The ship approached the pier.

Passive

The cub scouts were burned by the camp fire.
The construction worker was hit by the bulldozer.
The missing geologist was smothered by the volcano.
The secretary was splashed by the drinking fountain.
The quarterback was annoyed by the jukebox in the bar.
The surfer was excited by the stormy sea.

Locative
The students were working by the new sports complex.
The tourist was loitering by the blinking traffic light.
The 747 was landing by the airport's control tower.
The businessman was waiting by the airline ticket counter.
The scientist was sleeping by the apple tree.
The minister was praying by the broken stained glass.

LIST C
Active
The students tried the new sports complex.
The tourist misunderstood the blinking traffic light.
The 747 radioed the airport's control tower.
The businessman left the airline ticket counter.
The scientist examined the apple tree.
The minister fixed the broken stained glass window.

Passive
The stockbroker was sued by the client.
The woman was stung by the jellyfish.
The lumberjack was struck by the giant redwood tree.
The dog was protected by the fence.
The councilman was impressed by the new building.
The ship was damaged by the pier.

Locative
The cub scouts were singing by the camp fire.
The construction worker was digging by the bulldozer.
The missing geologist was wandering by the volcano.
The secretary was typing by the drinking fountain.
The quarterback was drinking by the jukebox in the bar.
The surfer was running by the stormy sea.

Double-Object Dative/Prepositional Dative/Object Complement

LIST A
Double-Object Dative
The mother read her older children a story
The volunteers sold the children some submarine sandwiches.
The candidate wrote the Republican mayor a letter.
The ambassador's secretary sent the marine a watch.
The freshman took the Salvation Army some clothes.
The breeder showed the young family his best dogs.

Prepositional Dative
The king promised his daughter to the triumphant knight.
The choir sang a new hymn to the wedding guests.
The defendant told a lie to the suspicious lawyer.
The diplomat took the secret documents to the President.
The president told a joke to a Russian reporter.
The widow rented the upstairs rooms to student tenants.

Object Complement
The students named the book a classic.
The theater manager nominated Mary Best Actress.
The housewife considered the church her second home.
That couple's son made their garage an apartment.
Proctor and Gamble appointed the drugstore owner chairman.
The children elected the nurses' group their favorite volunteers.

LIST B
Double-Object Dative
The king promised the triumphant knight his daughter.
The choir sang the wedding guests a new hymn.
The defendant told the suspicious lawyer a lie.
The diplomat took the President the secret documents.
The president told the Russian reporter a joke.
The widow rented the student tenants the upstairs rooms.

Prepositional Dative
The students brought a book to Stella.
The actress sold her jewelry to the stage manager.
The housewife mailed a check to the bankrupt church.
The couple rented the garage to their neighbor's son.
Proctor and Gamble sent samples of the new detergent to consumers.
The children sang a song to the nurses' group.

Object Complement
The mother appointed the older children "official babysitters."
The volunteers considered submarine sandwiches the perfect lunch.
The Republican party elected the candidate mayor.
The ambassador's secretary assigned the marine Captain of the Watch.
The freshmen named the Salvation Army their favorite charity.
The breeder made family pets his top priority

LIST C
Double-Object Dative
The students brought Stella a book.
The actress sold the stage manager her jewelry.
The housewife mailed the minister's bankrupt church a check.

The couple rented the neighbor's son their garage.
Proctor and Gamble sent consumers samples of the new detergent
The children sang the nurses' group a song.

Prepositional Dative
The mother read a story to her older children.
The volunteers sold some submarine sandwiches to the children.
The candidate wrote a letter to the Republican mayor.
The ambassador's secretary sent a watch to the marine.
The freshman took some clothes to the Salvation Army.
The breeder showed his best dogs to the young family.

Object Complement
The king's daughter considered the triumphant knight her fiancé.
The choir considered the new hymn their favorite song.
The suspicious lawyer deemed the defendant a liar.
The diplomat made delivering the documents his primary mission.
The president appointed the Russian reporter his joke writer.
The widow deemed the upstairs room a disaster area.

Conjoined/Center-Embedded/Right-Embedded

LIST A
Conjoined
The man spilled the wine and he stained the carpet.
The monkey looked under the bowl and then he hid his food.
The girl interrupted the boy who was talking very loudly.
The gambler chose the number and he won the lottery.
The mother punished the boy and then she broke the vase.
The girl smelled the flower and it reminded her of her grandmother.

Center-Embedded
The boys that teased the girl answered all the questions.
The man that wore white pants had stains on his knees.
The woman that scolded the boy climbed the tree.
The carpenter that hit the man was riding a bike.
The boy that was annoying the woman was talking on the phone.
The spy that carried the briefcase had the confidential documents.

Right-Embedded
The mechanic adjusted the fitting that closed the valve.
The carpenter drove the car that won the race.
The man kicked the dog that was chasing the cat.
The student bought a calculator that does calculus.
The woman wore a locket that was her grandmother's.
The waitress threw the dart that hit the bull's eye.

LIST B

Conjoined

The mechanic adjusted the fitting and then he closed the valve.
The driver drove the car and he won the race.
The man kicked the dog and then he chased the cat.
The student bought a calculator because she did calculus.
The woman wore a locket and it was her grandmother's.
The waitress threw the dart and she hit the bull's eye.

Center-Embedded

The man that spilled the wine stained the carpet.
The monkey that looked under the bowl was hiding his food.
The girl that interrupted the boy was humming very loudly.
The gambler that chose the number won the lottery.
The mother that punished the boy dropped the vase.
The girl that smelled the flower was very pretty.

Right-Embedded

The boys teased the girl who answered all the questions.
The man wore white pants that had stains on the knee.
The woman scolded the boy who had climbed the tree.
The carpenter hit a man who was riding a bike.
The boy was annoying the woman who was talking on the phone.
The spy carried the briefcase that had the confidential documents.

LIST C

Conjoined

The boys teased the girl because she answered all the questions.
The man wore white pants and they had stains on the knee.
The woman scolded the boy because he climbed the tree.
The carpenter hit a man, but he rode away on a bike.
The boy was annoying the woman because she was talking on the phone.
The spy carried the briefcase because it held the confidential documents.

Center-Embedded

The mechanic that adjusted the fitting closed the valve.
The driver that drove the car won the race.
The man that kicked the dog was chasing the cat.
The student that bought a calculator takes calculus.
The woman that wore a locket was a grandmother.
The waitress that threw the dart hit the bull's eye.

Right-Embedded

The man spilled the wine that stained the carpet.
The monkey looked under the bowl that was hiding his food.
The girl interrupted the boy that was humming very loudly.

The gambler chose the number that won the lottery.
The mother punished the boy that dropped the vase.
The girl smelled the flower that was very pretty.

Filler Sentences

The books were expensive
The detective noticed the cuts on the bartender's hand
It was difficult to forget the photographs of the concentration camp
The acorns fell from the top of the oak tree.
The boy seems to enjoy the ice cream.
Nancy wants to redecorate the family room.
It was easy to hide the money.
The house took fifty years to build
Henry Vlll married Jane Seymour
Bob Dole used to be in the Senate.
The desk is in the room.
The surgeon cut himself with a scalpel.
The staff burned the incriminating papers.
Jackhammers are noisy.
The stockbroker was angry about the rising interest rates.
The freezing rain made the street slippery.
There is a red spot on Jupiter.
There were thirteen original colonies.
The stuntman threw himself out of the window.
It was tough to fail the tennis class.
That Billy was unhappy was apparent from his expression.
The president of UF is Bernie Machen.
George Bush is the president.
There were several witnesses to the three car accident.
The shaken victim described her assailant.
The freezing rain made the street slippery.
There were a lot of earthquakes last year.
The anger of the crowd was hard to understand.
There are thirty players in the tournament.
McDonald's is the largest restaurant chain in the world.
The weather was nice.
That eighteen-year old fulfilled all the requirements for a bachelor's degree.
The accident was inexplicable.
Working on a computer can be frightening.
The football fans lined up at the gate.
The refrigerator hasn't been defrosted in months.
The stockbroker was angry about the rising interest rates.
Liberace died after a serious illness.
The blouse had a button missing.
It was impossible to answer all the questions.

Shirley MacLaine played herself in one of her movies.
Some of the trees on University Ave. are diseased
A famous scientist is appearing on the Discovery Channel.
Independence Hall is on Chestnut Street in Philadelphia.
Robert E. Lee surrendered in Virginia
The calculator is broken.

Priming Sentence Sets and Matched Target Pictures

Transitive Sentences

Priming sentence set:
Active: The students tried the new sports complex.
Passive: The students were bankrupted by the new sports complex.
Locative: The students were working by the new sports complex.
Target picture: Toy startles little girl

Priming sentence set:
Active: The cub scouts enjoyed the camp fire.
Passive: The cub scouts were burned by the camp fire.
Locative: The cub scouts were singing by the camp fire.
Target picture: Ambulance hits policeman

Priming sentence set:
Active: The construction worker drove the bulldozer.
Passive: The construction worker was hit by the bulldozer.
Locative: The construction worker was digging by the bulldozer.
Target picture: Sailor kicking soldier

Priming sentence set:
Active: The missing geologist underestimated the volcano.
Passive: The missing geologist was smothered by the volcano.
Locative: The missing geologist was wandering by the volcano.
Target picture: Avalanche scares skiers

Priming sentence set:
Active: The secretary cleaned the drinking fountain.
Passive: The secretary was splashed by the drinking fountain.
Locative: The secretary was typing by the drinking fountain.
Target picture: Train runs into bus

Priming sentence set:
Active: The quarterback destroyed the jukebox in the bar.
Passive: The quarterback was annoyed by the jukebox in the bar.
Locative: The quarterback was drinking by the jukebox in the bar.
Target picture: Girl kicking a boy

Priming sentence set:
Active: The surfer watched the stormy sea.
Passive: The surfer was excited by the stormy sea.
Locative: The surfer was running by the stormy sea.
Target picture: Lightning strikes church

Priming sentence set:
Active: The stockbroker impressed the client.
Passive: The stockbroker was sued by the client.
Locative: The stockbroker was sitting by the client.
Target picture: Dog chases mailman

Priming sentence set:
Active: The woman caught the jellyfish.
Passive: The woman was stung by the jellyfish.
Locative: The woman was swimming by the jellyfish.
Target picture: Horse kicks cow

Priming sentence set:
Active: The tourist misunderstood the blinking traffic light.
Passive: The tourist was confused by the blinking traffic light.
Locative: The tourist was loitering by the blinking traffic light.
Target picture: Hydrant squirts fireman

Priming sentence set:
Active: The 747 radioed the airport's control tower.
Passive: The 747 was alerted by the airport's control tower.
Locative: The 747 was landing by the airport's control tower.
Target picture: Turtle squirts a mouse

Priming sentence set:
Active: The businessman left the airline ticket counter.
Passive: The businessman was paged by the airline ticket agent.
Locative: The businessman was waiting by the airline ticket counter.
Target picture: Wrecking ball destroys building

Priming sentence set:
Active: The minister fixed the broken stained glass window.
Passive: The minister was cut by the broken stained glass window.
Locative: The minister was praying by the broken stained glass.
Target picture: Tornado destroys barn

Priming sentence set:
Active: The scientist examined the apple tree.
Passive: The scientist was inspired by the apple tree.

Locative: The scientist was sleeping by the apple tree.
Target picture: Woman kisses man

Priming sentence set:
Active: The councilman opened the new building.
Passive: The councilman was impressed by the new building.
Locative: The councilman was strolling by the new building.
Target picture: Rock hits boy on head

Priming sentence set:
Active: The ship approached the pier.
Passive: The ship was damaged by the pier.
Locative: The ship was docking by the pier.
Target picture: Boy is saving a girl from drowning

Priming sentence set:
Active: The lumberjack struck the giant redwood tree.
Passive: The lumberjack was struck by the giant redwood tree.
Locative: The lumberjack was eating by the giant redwood tree.
Target picture: Fireman rescues baby from fire

Priming sentence set:
Active: The dog jumped the fence.
Passive: The dog was protected by the fence.
Locative: The dog was barking by the fence.
Target picture: Bee stings man

Dative Sentences

Priming sentence set:
Double-Object Dative: The candidate wrote the Republican mayor a letter.
Prepositional Dative: The candidate wrote a letter to the Republican mayor.
Object Complement: The Republican Party elected the candidate mayor.
Target picture: Waitress give menu to man

Priming sentence set:
Double-Object Dative: The mother read her older children a story.
Prepositional Dative: The mother read a story to her older children.
Object Complement: The mother appointed the older children "official babysitters."
Target picture: Boy giving apple to teacher

Priming sentence set:
Double-Object Dative: The volunteers sold the children some submarine sandwiches.
Prepositional Dative: The volunteers sold some submarine sandwiches to the children.
Object Complement: The volunteers considered submarine sandwiches the perfect lunch.
Target picture: Guy gives guitar to musician

Priming sentence set:
Double-Object Dative: The ambassador's secretary sent the marine a watch.
Prepositional Dative: The ambassador's secretary sent a watch to the marine.
Object Complement: The ambassador's secretary assigned the marine Captain of the Watch.
Target picture: Girl hands paintbrush to boy on ladder

Priming sentence set:
Double-Object Dative: The freshmen took the Salvation Army some clothes.
Prepositional Dative: The freshmen named the Salvation Army their favorite charity.
Object Complement: The freshmen named the Salvation Army their "favorite charity."
Target picture: Salesman shows car to a couple

Priming sentence set:
Double-Object Dative: The breeder showed the young family his best dogs.
Prepositional Dative: The breeder showed his best dogs to the young family.
Object Complement: The breeder made family pets his top priority.
Target picture: Boy and girl give flowers to the man

Priming sentence set:
Double-Object Dative: The king promised the triumphant knight his daughter.
Prepositional Dative: The king promised his daughter to the triumphant knight.
Object Complement: The king's daughter considered the triumphant knight her fiancé.
Target picture: Cowboy gives hat to clown

Priming sentence set:
Double-Object Dative: The choir sang the wedding guests a new hymn.
Prepositional Dative: The choir sang a new hymn to the wedding guests.
Object Complement: The choir considered the new hymn their favorite song.
Target picture: Girl reads to boy

Priming sentence set:
Double-Object Dative: The defendant told the suspicious lawyer a lie.
Prepositional Dative: The defendant told a lie to the suspicious lawyer.
Object Complement: The suspicious lawyer deemed the defendant a liar.
Target picture: Waitress served drinks to man

Priming sentence set:
Double-Object Dative: The diplomat took the President the secret documents.
Prepositional Dative: The diplomat took the secret documents to the President.
Object Complement: The diplomat made delivering the documents his primary mission.
Target picture: Boy and girl show picture to the teacher

Priming sentence set:
Double-Object Dative: The president told the Russian reporter a joke.
Prepositional Dative: The president told a joke to a Russian reporter.

Object Complement: The president appointed the Russian reporter his joke writer.
Target picture: Lawyer shows gun to judge

Priming sentence set:
Double-Object Dative: The widow rented the student tenants the upstairs rooms.
Prepositional Dative: The widow rented the upstairs rooms to student tenants.
------: The widow deemed the upstairs room a disaster area.
Target picture: Man is passing pitcher to woman

Priming sentence set:
Double-Object Dative: The students brought Stella a book.
Prepositional Dative: The students brought a book to Stella.
Object Complement: The students named the book a classic.
Target picture: Nurse gives stethoscope to doctor

Priming sentence set:
Double-Object Dative: The actress sold the stage manager her jewelry.
Prepositional Dative: The actress sold her jewelry to the stage manager.
Object Complement: The stage manager nominated Mary Best Actress.
Target picture: Boy gives valentine to girl

Priming sentence set:
Double-Object Dative: The housewife mailed the minister's bankrupt church a check.
Prepositional Dative: The housewife mailed a check to the bankrupt church.
Object Complement: The housewife considered the church her second home.
Target picture: Woman throws stick to dog

Priming sentence set:
Double-Object Dative: The couple rented the neighbor's son their garage.
Prepositional Dative: The couple rented the garage to their neighbor's son.
Object Complement: That couple's son made their garage an apartment.
Target picture: Cop gives ticket to man

Priming sentence set:
Double-Object Dative: Proctor and Gamble sent consumers samples of the new detergent.
Prepositional Dative: Proctor and Gamble sent samples of the new detergent to consumers.
Object Complement: Proctor and Gamble appointed the drugstore owner chairman.
Target picture: Librarian gives book to boy

Priming sentence set:
Double-Object Dative: The children sang the nurses' group a song.
Prepositional Dative: The children sang a song to the nurses' group.
Object Complement: The children elected the nurses' group their favorite volunteers.
Target picture: Waitress gives menu to man

Conjoined-Embedded Sentences

Priming sentence set:
Conjoined: The man spilled the wine and he stained the carpet.
Center-Embedded: The man that spilled the wine stained the carpet.
Right-Embedded: The man spilled the wine that stained the carpet.
Target picture: Boy chasing cat, cat chasing duck

Priming sentence set:
Conjoined: The monkey looked under the bowl and then he hid his food.
Center-Embedded: The monkey that looked under the bowl was hiding his food.
Right-Embedded: The monkey looked under the bowl that was hiding his food.
Target picture: Boy touching girl, girl touching monkey

Priming sentence set:
Conjoined: girl interrupted the boy that was humming very loudly.
Center-Embedded: The girl that interrupted the boy was humming very loudly.
Right-Embedded: The girl interrupted the boy who was talking very loudly.
Target picture: Cat and boy kicking girl

Priming sentence set:
Conjoined: The gambler chose the number and he won the lottery.
Center-Embedded: The gambler that chose the number won the lottery.
Right-Embedded: The gambler chose the number that won the lottery.
Target picture: Dog chasing girl, girl chasing boy

Priming sentence set:
Conjoined: The mother punished the boy and then she broke the vase.
Center-Embedded: The mother that punished the boy dropped the vase.
Right-Embedded: The mother punished the boy that dropped the vase.
Target picture: Dog biting cat, cat biting girl

Priming sentence set:
Conjoined: The girl smelled the flower and it reminded her of her grandmother.
Center-Embedded: The girl that smelled the flower was very pretty.
Right-Embedded: The girl smelled the flower that was very pretty.
Target picture: Man pulling woman, woman pulling dog

Priming sentence set:
Conjoined: The mechanic adjusted the fitting and then he closed the valve.
Center-Embedded: The mechanic that adjusted the fitting closed the valve.
Right-Embedded: The mechanic adjusted the fitting that closed the valve.
Target picture: Bear leading girl, girl leading boy

Priming sentence set:
Conjoined: The driver drove the car and he won the race.

Center-Embedded: The driver that drove the car won the race.
Right-Embedded: The driver drove the car that won the race.
Target picture: Monkey patting girl, cat jumping on girl

Priming sentence set:
Conjoined: The man kicked the dog and then he chased the cat.
Center-Embedded: The man that kicked the dog was chasing the cat.
Right-Embedded: The man kicked the dog that was chasing the cat.
Target picture: Boy watching bear spying on bird

Priming sentence set:
Conjoined: The student bought a calculator because she did calculus.
Center-Embedded: The student that bought a calculator takes calculus.
Right-Embedded: The student bought a calculator that does calculus.
Target picture: Girl pulling cat and chasing baby

Priming sentence set:
Conjoined: The woman wore a locket and it was her grandmother's.
Center-Embedded: The woman that wore a locket was a grandmother.
Right-Embedded: The woman wore a locket that was her grandmother's.
Target picture: Girl pulling baby and dog

Priming sentence set:
Conjoined: The waitress threw the dart and she hit the bull's eye.
Center-Embedded: The waitress that threw the dart hit the bull's eye.
Right-Embedded: The waitress threw the dart that hit the bull's eye.
Target picture: Bear spying on man looking at boy

Priming sentence set:
Conjoined: The man wore white pants and they had stains on the knee.
Center-Embedded: The man that wore white pants had stains on his knees.
Right-Embedded: The man wore white pants that had stains on the knee.
Target picture: Cat kicking girl, girl kicking boy

Priming sentence set:
Conjoined: The boys teased the girl because she answered all the questions.
Center-Embedded: The boys that teased the girl answered all the questions.
Right-Embedded: The boys teased the girl who answered all the questions.
Target picture: Boy trying to pat cat, cat scratching dog

Priming sentence set:
Conjoined: The woman scolded the boy because he climbed the tree.
Center-Embedded: The woman that scolded the boy climbed the tree.
Right-Embedded: The woman scolded the boy who had climbed the tree.
Target picture: Woman staring at man, man watching baby

Priming sentence set:
Conjoined: The carpenter hit a man, but he rode away on a bike.
Center-Embedded: The carpenter that hit the man was riding a bike.
Right-Embedded: The carpenter hit a man who was riding a bike.
Target picture: Monkey patting boy, boy patting girl

Priming sentence set:
Conjoined: The boy was annoying the woman because she was talking on the phone.
Center-Embedded: The boy that was annoying the woman was talking on the phone.
Right-Embedded: The boy was annoying the woman who was talking on the phone.
Target picture: Woman pulling man and dog

Priming sentence set:
Conjoined: The spy carried the briefcase because it held the confidential documents.
Center-Embedded: The spy that carried the briefcase had the confidential documents.
Right-Embedded: The spy carried the briefcase that had the confidential documents.
Target picture: Girl leading bear, bear leading boy

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BIOGRAPHICAL SKETCH

Maisa Haj-Tas obtained a BA in English language and literature and an MA is speech pathology in her home country Jordan. She was a teacher of English as a second language for several years before she came to UF in 2001 to pursue a doctoral degree is speech pathology and was a teaching assistant there until the end of fall, 2006. She worked on several research projects with her advisor Dr. Kenneth Logan and presented several original papers at one international and several national conventions.

Since early 2007 until the end of the Summer semester of that year, Maisa was a teaching assistant at the English Language Institute at UF where she taught reading and writing skills to intermediate level second language learners.

During her years at UF, Maisa was an active member in the International Student Speakers Bureau and presented several talks to students at schools in Gainesville about her country and culture. She was awarded the Alec Courtelis award for outstanding international student in 2006 for her contribution and activities at UF. She also received several other prestigious awards among which were the Grinter Fellowship, the Dissertation Fellowship, in addition to several travel awards from her department, college, and the graduate school at UF.

Upon completion of her doctoral work at UF, Maisa plans to go back to Jordan and will join the faculty at the University of Jordan. She is proud to say that she is the first person in her country of about five million people with a doctoral degree in stuttering. He future plans include teaching, conducting research, and assisting in the fluency clinic.