Journal of Fluency Disorders 57 (2018) 1–10

Contents lists available at ScienceDirect

Journal of Fluency Disorders

journal homepage: www.elsevier.com/locate/jfludis

# Speech rate adjustment of adults during conversation

Debora Freud*, Ruth Ezrati-Vinacour, Ofer Amir

*Department of Communication Disorders, Sackler Faculty of Medicine, Tel Aviv University, Israel*

ARTICLE INFO

*Keywords:*
Speech rate convergence
Speech rate reduction
Modeling

ABSTRACT

*Purpose:* Speech rate convergence has been reported previously as a phenomenon in which one's speech rate is influenced by his/her partner's speech rate. This phenomenon has been demonstrated in artificial settings, and to some extent, in mother-child interactions. The purpose of this study was to explore speech rate adjustment in a quasi-natural adult-adult conversation.
*Methods:* An A-B-A-B paradigm was used, in which ten adults conversed on a given topic with two experimenters. Speech rates of both communication partners were measured.
*Results:* Participants significantly reduced their speech rate, in response to the experimenters' reduction in speech rate. However, the participants' reduction in speech rate was significantly smaller than the experimenters' reduction in speech rate. In addition, during the controlled slow speech rate, the participants' speech rate correlated negatively with that of the experimenters'.
*Conclusion:* Results suggest that speech rate convergence is a non-linear phenomenon, and may be affected by various linguistic as well as communicational factors. From a clinical perspective, the results support the use of the modeling strategy in speech therapy, as a means to facilitate a reduction in clients' speech rate.

## 1. Introduction

The strategy of slowing down an individual's speech rate is a common practice in speech therapy. It has been used for individuals with dysarthria and apraxia (e.g., Pilon, McIntosh, & Thaut, 1998; Wambaugh, Duffy, McNeil, Robin, & Rogers, 2006; Yorkston, Hammen, Beukelman, & Traynor, 1990), voice disorders (e.g., Stemple, Glaze, & Gerdeman-Klaben, 2000; Trail et al., 2005), cluttering (e.g., Myers, 1992; St. Louis, Myers, Bakker, & Raphael, 2007) and probably most commonly, for individuals with stuttering (e.g., Adams, Lewis, & Besozzi, 1973; Guitar, 2006; Langevin, Kully, Teshima, Hagler, & Narasimha Prasad, 2010; Trajkovski, Andrews, O'Brian, Onslow, & Packman, 2006; Yairi & Seery, 2011).

In stuttering therapy, slowing down speech rate is intended mainly to enhance speech fluency. This is done under the assumption that it allows additional time for planning and synchronizing the language and speech systems, as well as for facilitating the continuous and smooth transition between speech sounds (Robb, Maclagan, & Chen, 2004). Regulating and slowing speech rate has ancient roots in the history of speech and stuttering therapy. It has always been a key component in many stuttering therapy approaches, and especially in fluency-shaping oriented approaches (de I'Isere, 1840; Van Dantzig, 1940). Hence, slowing speech rate is employed in both *indirect* and *direct* stuttering therapies.

For young children, *indirect* therapy approaches, such as the 'Palin Parent-Child Interaction Therapy' (Kelman & Nicholas, 2008), are often applied. A key component of these approaches is changing parental speech style to match the child's communicational needs, and to enhance the child's fluency. Accordingly, reducing parental speech rate may be one of the basic therapeutic goals, aimed to eventually reduce the child's speech rate (Kelman & Nicholas, 2008; Rustin, Botterill, & Kelman, 1996). In contrast, *direct*

* Corresponding author at: Department of Communication Disorders, Tel Aviv University, Sheba Medical Centre, Tel Hashomer 52621, Israel.
*E-mail address:* deborafreud@post.tau.ac.il (D. Freud).

https://doi.org/10.1016/j.jfludis.2018.06.002
Received 4 November 2017; Received in revised form 14 May 2018; Accepted 18 June 2018
Available online 23 June 2018

stuttering therapy approaches for children are often based on metaphors, such as "turtle talk" (Meyers & Woodford, 1992) or "bus talking" (Kelman & Nicholas, 2008), combined with a model provided by the clinician. In these approaches, the clinician introduces the child to a speech pattern, which is produced at a slow rate.

For adults, stuttering therapy includes an array of approaches, aiming to improve the client's speech and quality of life. In general terms, on the one end of the continuum are psychological approaches, aimed to reduce negative feelings and attitudes towards stuttering (e.g., Beilby, Byrnes, & Yaruss, 2012; Ginsberg & Wexler, 2000; Menzies et al., 2008; Nicholas, 2015). On the other end, there are approaches which directly target the speech symptoms per se (e.g., Boberg, 1976; Webster, 1980). Along the continuum between these two ends, there are many integrated therapy approaches, in which both feelings, attitudes and speech symptoms are addressed (e.g., Bloodstein, 1995; Guitar, 2006; Menzies et al., 2008; Van Riper, 1982). Regardless of the specific therapy approach selected, therapy programs which target speech fluency are considered *direct*, and usually encourage the client to produce slower speech. Traditionally, the client was instructed to slow his/her speech rate, and to match an external pace, using a metronome for example (Brady, 1971; de I'Isere, 1840; Meyer & Mair, 1963). Currently, slowing speech rate is achieved, for example, by direct instructions to prolong specific (or all) speech sounds. In most cases, the reduction in the client's speech rate is elicited by the SLP's model (e.g., Guitar, 2006; Kully & Langevin, 1999). In more recent approaches, such as the 'Camperdown' program, for example, modeling is a major component. Hence, the client may watch a video of the clinician modeling prolonged speech, and is expected to adopt this speech pattern, without explicit instructions (O'Brian, Onslow, Cream, & Packman, 2003).

Interestingly, while speech rate modeling is widely used for eliciting a reduction in stuttering (e.g., Carey, O'Brian, Onslow, Packman, & Menzies, 2012; Millard, Nicholas, & Cook, 2008; Millard, Edwards, & Cook, 2009; O'Brian et al., 2003), the direct effect of speech rate modeling on the client's speech rate remains unclear. This was examined, for example, in a study that observed two mother-child dyads, and included children-who-stutter (CWS) (Stephenson-Opsal & Bernstein-Ratner, 1988). Mothers in that study were trained to slow their speech rate while interacting with their child. Results suggested that as the mothers slowed their speech rate, the children's stuttering decreased, but not their speech rate. Such findings are surprising since the underlying assumption of this therapy approach is that slowing the mother's speech rate induces a reduction in the child's speech rate, which – in turn – leads to a reduction in stuttering. Therefore, it was suggested that the reduction in the mother's speech rate led to a reduction in language complexity, which may have affected the child's fluency. Similar results were also reported in another study that examined five mother-CWS dyads (age range 2–7) in three different speech tasks (Zebrowski, Weiss, Savelkoul, & Hammer, 1996). This study reported a moderate tendency for a reduction in the children's speech rate, in response to the mothers' slow speech rate. However, this reduction in speech rate failed to reach statistical significance.

The possibility of a speech rate adjustment between two communication partners, was examined not only among people-who-stutter, but also among fluent speakers (both children and adults). In children, previous studies have presented inconclusive findings. Bernstein-Ratner (1992), for example, examined 20 mothers who were recorded during a natural interaction with their normally developed children for 15 min. The same dyads were re-examined two weeks later, and the mothers were instructed to use a slow speech rate. Results indicated that, despite the mothers' reduction in speech rate, there was no rate reduction in the children's speech (Bernstein-Ratner, 1992). This result replicates earlier reports by Stephenson-Opsal and Bernstein-Ratner (1988), as well as by Zebrowski et al. (1996), who found that young fluent children do not adjust their speech rate in response to their mothers' speech rate.

In contrast, other studies have concluded that young children *do* exhibit a reciprocal adjustment (also referred to, as *convergence*) of speech rate during a conversation. For example, Street, Street, and Van Kleek, (1983) reported that young (fluent) children demonstrated a speech rate adjustment during a conversation with unfamiliar adults, even at the early age of 3-years. In another study, six mothers and their typically fluent children (age 3–4) participated in a single-subject A-B-A-B paradigm ("A" represents *normal* speech rate, and "B" represents *slow* rate). Results revealed that children significantly reduced their speech rate in response to the reduction in the mothers' speech rate. Moreover, a positive correlation was found between the mothers' and children's speech rates (Marchinkoski & Guitar, 1994). Notably, the latter study is especially relevant to the present study, due to its specific methodology, which combines the advantages of a naturalistic study with those of a structured test-retest design.

In adults, studies that have examined the possibility of speech rate reciprocal adjustment, have used different paradigms, different speech tasks and different instructions. Therefore, it is difficult to compare these studies and their results. Only a few studies adopted a relatively naturalistic approach, whereas most studies used a more structured and controlled setting. Street (1984), for example, reported that 40 undergraduate students demonstrated a reciprocal adjustment of speech rate during recorded interviews with adults, which were conducted as a part of an academic assignment in an interviewing course (Street, 1984). This comprehensive study, however, had several methodological caveats. First, the nature of the adjustment was not described as details were not provided. Second, despite the general report on the adjustment (i.e., convergence), inspection of the individual dyads reveals that, in fact, not all dyads have demonstrated a reciprocal adjustment of speech. Therefore, the conclusions drawn from this study should be evaluated in light of these conditions.

A more structured design was used by Jungers and Hupp (2009). They examined 20 adults who described a picture, after listening to its description at two speech rates. They reported that speakers adjusted their speech rate to that of the speakers in the recordings. Yet another methodology was used by Cummins (2009), who reported that four adult speakers successfully adjusted their speech rate, to match a simultaneous playback of different speakers reading a given text. A similar report was made by Schultz et al. (2016), who concluded that, during a dialogue reading task, untrained speakers adjusted their speaking rate, to match that of their dialogue partner.

It should be clarified that the phenomenon of 'adjustment' of specific speech characteristics between communication partners is not exclusive to speech rate. It has been previously referred to, as *speech accommodations* (Giles et al., 1991), *speech convergence*

(Street, 1984) or *conversational synchrony* (Richardson, Dale, & Shockley, 2008). Speakers were shown to adopt various speech and verbal characteristics from their partner. These include, for example, syntactic structures (Branigan, Pickering, & Cleland, 2000; Hupp & Jungers, 2009), utterance and pause length (Giles et al., 1991), pronunciation (Pardo, 2006) and vocal loudness (Natale, 1975). Other, nonverbal features, such as eye movements (Richardson & Dale, 2005), respiration (McFarland, 2001) and posture alternations (Shockley, Santana, & Fowler, 2003) were also shown to synchronize between speakers.

The mechanism and the potential advantage of such adjustments are yet unclear. Street (1984), for example, argued that they are intended, primarily, to enhance communication effectiveness. Others have suggested that these adjustments are driven by a social motivation to facilitate social integration, express mutual identification or to gain social approval, by becoming "more similar" (e.g., D'Agostino & Bylund, 2014; Giles et al., 1991; Natale, 1975). An intriguing manifestation of this effect was reported in a physician-client study, in which clients expressed higher satisfaction ratings, when their physician used a similar loudness and speech rate compared to theirs (Ishikawa et al., 2006). Interestingly, such assimilation phenomenon are clearly not unique to humans, and may be found in other species. Examples for reciprocal adjustment in animals may be found in simultaneous maneuvering of individual members of a flying flock of shorebirds, or in "contagious" yawning among chimpanzees (Byrne, 2009). Vocal convergence is also seen in budgerigar parrots, who begin to imitate the contact calls of their assigned mates within a short time, and develop a shared and unique call (Hile, Plummer, & Striedter, 2000). Another example was provided by Van de Waal and Whiten (2012)) who reported that primates learn new techniques for obtaining food, by mimicking the behavior of other group members. Such behaviors are viewed as providing an advantage in specific conditions, such as in the struggle for survival when facing predators, during mating season or while adapting to a new habitat.

The present study focuses on speech rate adjustment between adult speakers. As noted, the mechanism for speech rate adjustment is yet unclear. It has been suggested that it has neurophysiological bases, such that underlying mirror neurons have evolved to act to promote communication (Dale & Spivey, 2006). Others have suggested that this may be the product of neural beat perception, just like listeners perceive a musical beat and respond by (unconscious) head nodding or foot tapping (Large, 2008). In that respect, Schultz et al. (2016) hypothesized that speech rate accommodations may result from listeners' perception of beat from the speech of their communication partners, and adjusting their speech, and more specifically - their speech rate - to that beat. This scheme is based on the *Dynamic Attending Theory* (Jones, 2009; Large & Jones, 1999), which describes the synchronization of neural oscillations to time-based regularities in the presence of an external stimuli.

In summary, for many years, professionals have been using modeling, as a therapeutic approach for modifying clients' speech performance and especially, to reduce speech rate. Various studies have previously documented speech rate convergence, but it is difficult to draw a conclusion from those studies, due to differences in their methodologies. The majority of these studies have examined speech rate convergence in structured settings, which are markedly different from natural conversation or from a typical speech therapy session. Only a few studies have used naturalistic settings. These studies were mostly conducted on adult-child dyads. The A-B-A-B paradigm (e.g., Marchinkoski & Guitar, 1994), described above, provides a semi-natural setting, which has the potential of contributing to our understanding of the speech rate convergence mechanism. Therefore, the purpose of the present study was to examine *speech rate adjustment* in adults, using the A-B-A-B paradigm. Specifically, we were interested to learn whether adjustment of speech rate can be found in adult speakers, and to what extent such adjustment may affect their speech rate.

## 2. Material and methods

### 2.1. Participants

After receiving the approval of our Institutional Review Board, all participants completed and signed a written informed consent form. Ten young men volunteered to participate in this study. Table 1 summarizes background information on the participants,

**Table 1**
Background characteristics of the participants, including age, educational level, marital status and occupational status.

| | *N (%)* |
|---|---|
| **Age** (years) | |
| Mean | 30.8 |
| SD | 2.44 |
| Range | 29-35 |
| **Educational level** | |
| High-school | 1 (10%) |
| University | 9 (90%) |
| **Marital status** | |
| Single/divorced | 5 (50%) |
| Married | 5 (50%) |
| **Occupational status** | |
| Paid work | 10 (100%) |
| Unemployed | 0 (0%) |

including age, educational level, marital and occupational status.

All participants were adults, proficient speakers of Hebrew, with no reported speech, language or hearing problems. In addition, none of the participants had any reported physical, neurological or psychiatric disorder.

### 2.2. Procedures

#### 2.2.1. Experimenters

Two young women (age 23 and 26) with no reported speech or hearing problems, participated in this study, as experimenters. Prior to the study, their speech was assessed by an SLP, and their habitual speaking rate was evaluated. The two experimenters were trained by an experienced SLP, to produce a slower speech rate than their habitual speech rate, using intentional pausing, selective syllable prolongation, and enhanced self-monitoring. The SLP has also ensured that reducing speech rate would not affect the experimenters' speech naturalness. Training consisted of three 15-minutes sessions. After completion of the training phase, both experimenters were re-assessed by an SLP, who confirmed their competence to participate in the study, and to modify their speech rate at will, from habitual to target (i.e., slow) rate.

#### 2.2.2. Design

An A-B-A-B paradigm was designed for the present study. This paradigm was similar to Guitar and Marchinkoski (2001), who investigated speech rate changes in normally fluent children who interacted with their mothers. Our design, however, was adapted to adults.

For this study, each participant was engaged in four conversations, two with each experimenter. Hence, a total of 40 sessions were examined. The participants were not aware of the purpose of the study, and were told that the study was designed to examine general human communication skills. Each participant was asked to converse with one of the experimenters on a given topic. The participants were presented with four topics for discussion in each session. These included: socio-theological conflicts, wearing leather products, the advantages and disadvantages of immigrating to another country, and legalizing the use of drugs. The order of the topics was changed randomly between participants.

Each conversation lasted five minutes, and then a five-minute break was given between conversations. In the first conversation (condition $A_1$), the participant interacted with the first experimenter ($E_1$), who used a normal speech rate. In the second conversation (condition $B_1$), the participant interacted with the second experimenter ($E_2$), who used a slow speech rate. Then, conditions were repeated, first with $E_1$ at a normal speech rate ($A_2$), then with $E_2$ at slow speech rate ($B_2$). To reduce a possible bias, the two experimenter ($E_1$ and $E_2$) switched roles between participants, such that both of them performed *normal* as well as *slow* speech rates with half of the participants.

Conversation sessions were conducted in a quiet room, and lasted approximately 30 min. All sessions were recorded using a Shure Microflex MX391/0 omnidirectional surface mount microphone, placed on the table center, between the experimenter and the participant, at a distance of 40–50 cm from both of them. Recordings were digitized, via a Centrance external sound card, onto a computer on a single channel, with a sampling rate of 44,100 Hz (16 Bit). Files were then analyzed using Praat software (Ver. 5.3.34) (Boersma & Weenink, 2017).

To assure that the experimenters indeed controlled their speech rate as intended, all sessions were monitored by an observer, who was also seated in the room during the conversation. When the experimenter used a faster speaking rate than intended or when speech naturalness was affected, a hidden cue was provided by the observer, to elicit the correct speaking rate. After the completion of each session, the experimenter's speech rate was calculated, to ensure the intended differences between normal and slow speaking rate were performed.

### 2.3. Data coding

Sessions were, first, transcribed, and then segmented into turns. A ‘turn’ was defined as a speech segment uttered by one speaker, limited by the other speaker's speech, and included all utterances produced by the speaker, until the other partner began to talk (Freud, Moria, Ezrati-Vinacour, & Amir, 2016; Kelly & Conture, 1992; Savelkoul, Zebrowski, Feldstein, & Cole-Harding, 2007). Speech rate was calculated, for each turn, by dividing the number of spoken syllables by turn duration (in seconds). Duration measurements were made from a combined view of the sound-wave display and a spectrographic display, along with auditory verification, using Praat, as described previously (e.g., Amir & Grinfeld, 2011; Rochman & Amir, 2013). Speech rate was calculated separately for the experimenters and for the participants. Finally, a mean speech rate value was derived for each participant and experimenter, for each session, based on all available turns.

### 2.4. Inter-judge reliability

To assess speech-rate measurement reliability, two sessions were randomly chosen and fully analyzed independently by two examiners. The participants’ speaking rates were analyzed, and compared to the original measurements. A Pearson correlation test yielded a strong correlation between the two measurements ($r = 0.92$, $p < 0.01$).

**Table 2**
Experimenters' and participants' mean speech rate (SPS) in conditions A and B.

| Conversation No. | Experimenters | | | | Participants | | | |
|---|---|---|---|---|---|---|---|---|
| | Condition A[a] | | Condition B[b] | | Condition A[a] | | Condition B[b] | |
| | $A_1$ | $A_2$ | $B_1$ | $B_2$ | $A_1$ | $A_2$ | $B_1$ | $B_2$ |
| 1 | 5.11 | 4.19 | 2.66 | 2.74 | 6.08 | 5.67 | 5.09 | 4.86 |
| 2 | 4.43 | 4.55 | 2.78 | 2.38 | 5.32 | 6.43 | 6.11 | 5.21 |
| 3 | 4.13 | 3.86 | 2.21 | 2.34 | 4.00 | 4.14 | 3.67 | 4.29 |
| 4 | 4.87 | 5.10 | 2.38 | 2.20 | 6.07 | 6.08 | 6.39 | 5.24 |
| 5 | 4.82 | 4.44 | 2.85 | 2.59 | 5.24 | 4.81 | 4.88 | 4.94 |
| 6 | 4.63 | 4.55 | 2.89 | 2.56 | 5.00 | 4.11 | 4.00 | 4.29 |
| 7 | 5.22 | 5.14 | 2.92 | 2.83 | 6.41 | 6.01 | 5.43 | 6.33 |
| 8 | 4.72 | 4.53 | 2.73 | 2.50 | 5.46 | 6.19 | 4.74 | 4.78 |
| 9 | 4.19 | 4.59 | 2.35 | 2.46 | 5.06 | 4.29 | 4.50 | 4.65 |
| 10 | 4.53 | 4.38 | 2.34 | 2.17 | 5.43 | 4.18 | 4.68 | 4.78 |
| Mean | 4.60 | | 2.54 | | 5.30 | | 4.94 | |
| (SD) | (0.37) | | (0.24) | | (0.82) | | (0.71) | |

[a] Condition A: experimenter speaks at a normal speech rate.
[b] Condition B: experimenter speaks at a slow speech rate.

## 3. Results

### 3.1. Experimenters' speech rate

As demonstrated in Table 2, the experimenters' speech rate in condition B was slower than their habitual speech rate in condition A, by an average of 45% (range 34.6–56.8%). A two-way ANOVA (Experimental condition X Repetitions) was performed to evaluate this difference, using a mixed methods modeling, in which the independent variables were nested within participants. Results confirmed a significant main effect for Experimental condition [$F(1,18) = 102.65, p < 0.0001$]. No significant main effect was found for Repetition ($p = 0.20$), and no significant interaction was found between Experimental condition and Repetition ($p = 0.88$). This indicates that, as intended, the experimenters produced a slower speech rate in condition B (slow), compared to condition A (normal). This analysis also confirmed that both presentations of each condition (i.e., repetitions $A_1$ and $A_2$, as well as $B_1$ and $B_2$) were consistent in their speech rates, and therefore comparable. It should be noted that the experimenters' mean habitual speech rate was slightly slower compared to that of the participants'.

### 3.2. Participants' speech rate

As demonstrated in Table 2, the participants' speech rate in condition B was slower than their speech rate in condition A, by an average of 6% (Range 2.7–22.7%). To evaluate this difference, a two-way ANOVA, using a mixed methods modeling was performed. Results confirmed a significant main effect for Experimental condition [$F(1,18) = 15.67, p < 0.001$]. In contrast, no significant main effect for Repetition ($p = 0.46$), nor a significant Experimental condition X Repetition interaction ($p = 0.69$) were found. These results indicate that, similar to the experimenters, participants produced a slower speech rate in condition B (slow) compared to condition A (normal). This analysis also confirmed that the difference in the participants' speech rates was consistent across repetitions.

As shown above, the experimenters slowed their speech rate by an average of 45%, while the participants reduced their speech rate by an average of 6%. To evaluate this difference, a two-way ANOVA was performed. Results confirmed a significant Speaker X Experimental condition interaction [$F(1,18) = 4.77, p = 0.04$]. This is illustrated in Fig. 1.

### 3.3. Individual rate differences

Fig. 2 provides a detailed illustration of the participants' and experimenters' individual speaking rates within each dyad and across all conditions. As shown, there is a consistent reduction in speech rate between conditions A and B. In addition, for the most parts, the reduction in speech rate was more clearly noticeable among the experimenters than among the participants.

Finally, to evaluate the relationship between the experimenters' and participants' speech rate in all dyads, follow-up analyses were conducted. Results revealed that during the slow rate conditions, a statistically significant *negative* correlation between the experimenters' and participants' speech rate was found ($B = -0.43, p = 0.0001$). In contrast, no statistically significant correlation was found between the experimenters' and participants' speech rate during the normal speech rate condition ($B = 0.15, p = 0.17$).

## 4. Discussion

This study examined speech rate adjustment (convergence) in adults, using an A-B-A-B paradigm, similar to that of Marchinkoski

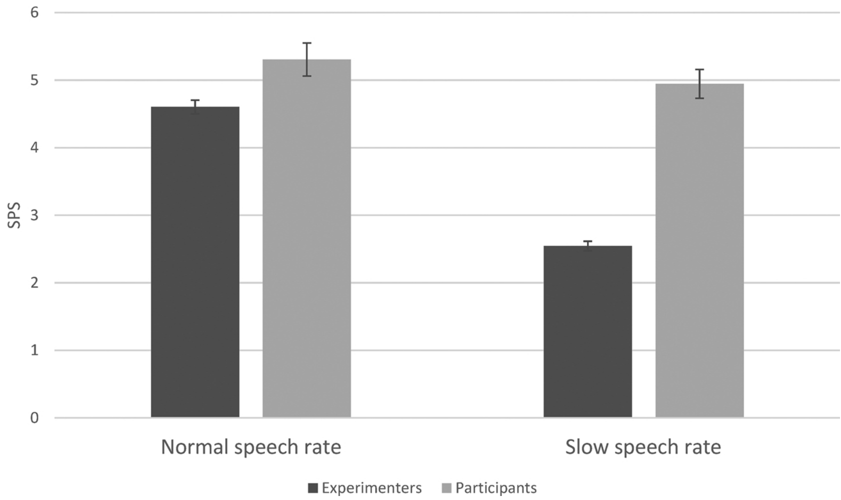


**Fig. 1.** Mean speech rate and standard error bars for the *Experimenters* and *Participants* in the normal speech rate condition (A), compared to the slow speech rate condition (B).

and Guitar (1994). Our study design included two experimenters who conversed individually with ten participants at "normal" and "slow" speech rates. We used a quasi-natural setting, to examine whether and to what extent speech rate adjustment occurs in adults.

The primary finding was that, indeed, adult speakers exhibited speech rate adjustments, in response to changes in the experimenters' speech rate. In other words, as the experimenters slowed their speech rate, so did the participants. Moreover, using the A-B-A-B paradigm has enabled to demonstrate that this adjustment was consistent across repeated sessions. This result is in agreement with previous reports on speech rate convergence in adults (Cummins, 2009; Jungers & Hupp, 2009; Schultz et al., 2016) and with some reports on children (Guitar & Marchinkoski, 2001).

Nonetheless, several methodological considerations should be discussed, when comparing the present results with previous reports. First, the present study examined speech rate adjustment in an emotionally neutral condition (a conversation on a given topic). In contrast, previous studies have used a wide range of speech tasks. These include, for example, reading scripted dialogues with an experimenter (Schultz et al., 2016), describing a picture following a priming phrase (Jungers & Hupp, 2009), playing with children (Bernstein-Ratner, 1992; Guitar & Marchinkoski, 2001; Stephenson-Opsal & Bernstein-Ratner, 1988; Zebrowski et al., 1996), and interview simulations (Street, 1984). Clearly, each of these speech tasks may impact the speakers' emotional status and modify the nature of the interaction. This, in turn, may affect speech rate and its adjustments. Second, the present study compared *habitual* to *slow* speech rates, whereas previous studies compared *fast* to *slow* speech rates (e.g., Jungers & Hupp, 2009; Schultz et al., 2016). Undoubtedly, the difference between *habitual* and *slow* speech rates (as performed in our study), is expected to yield less noticeable contrasts, compared to the *fast* versus *slow* speech rates, examined in previous studies. Third, the majority of previous studies did not monitor or control their experimenters' speech rate (e.g., Bernstein-Ratner, 1992; Guitar & Marchinkoski, 2001; Stephenson-Opsal & Bernstein-Ratner, 1988; Zebrowski et al., 1996). On the other hand, a few studies prompted the experimenters' speech rate externally, by a metronome (Jungers & Hupp, 2009; Schultz et al., 2016). These methodological approaches could easily impact the experimenters' speech rate and its naturalness, thus affecting conversation and its naturalness. Fourth, our study used the conventional syllable-per-second (SPS) metric, whereas other studies used various metrics. These include, for example, syllable duration (Jungers & Hupp, 2009), inter-beat intervals (Schultz et al., 2016), syllable-per-minute or word-per-minute (e.g., Guitar & Marchinkoski, 2001; Zebrowski et al., 1996), or relative vocalizing time (Street, 1984). Therefore, comparing current results with previous reports should be considered cautiously, due to these metric differences. Finally, speakers' characteristics varied tremendously between studies. Several studies examined mothers who conversed with young children-who-stutter (Zebrowski et al., 1996), whereas others included fluent children (Guitar & Marchinkoski, 2001). Moreover, several studies did not report on the gender of their participants (e.g., Jungers & Hupp, 2009). Such differences in experimenters' and participants' identity could affect the nature of the interaction, thus directly influence results.

Nonetheless, it is interesting to note that despite the considerable methodological differences between our study and previous reports, speech rate adjustment appears to be a solidly founded phenomenon among adults, which is evident regardless of the research paradigm. Moreover, the use of the A-B-A-B paradigm, has enabled us to illustrate the stability of this phenomenon, as it is portrayed across repetitions.

The second major finding of our study was that while experimenters reduced their speech rate by an average of 45%, participants reduced their speech rate only by 6%. In other words, the intentional speech rate reduction, performed by the experimenters, led to a smaller speech rate reduction among their conversation partners. This finding is reminiscent of two previous studies in which speech rate adjustments was examined in mother-child dyads. Specifically, Guitar and Marchinkoski (2001) reported that as mothers reduced their speech rate by 51%, their children reduced speech rate by 15%. Similarly, Zebrowski et al. (1996) reported that as mothers reduced their speech rate by 25%, their children reduced their speech rate by 9%. As noted, the current findings are in

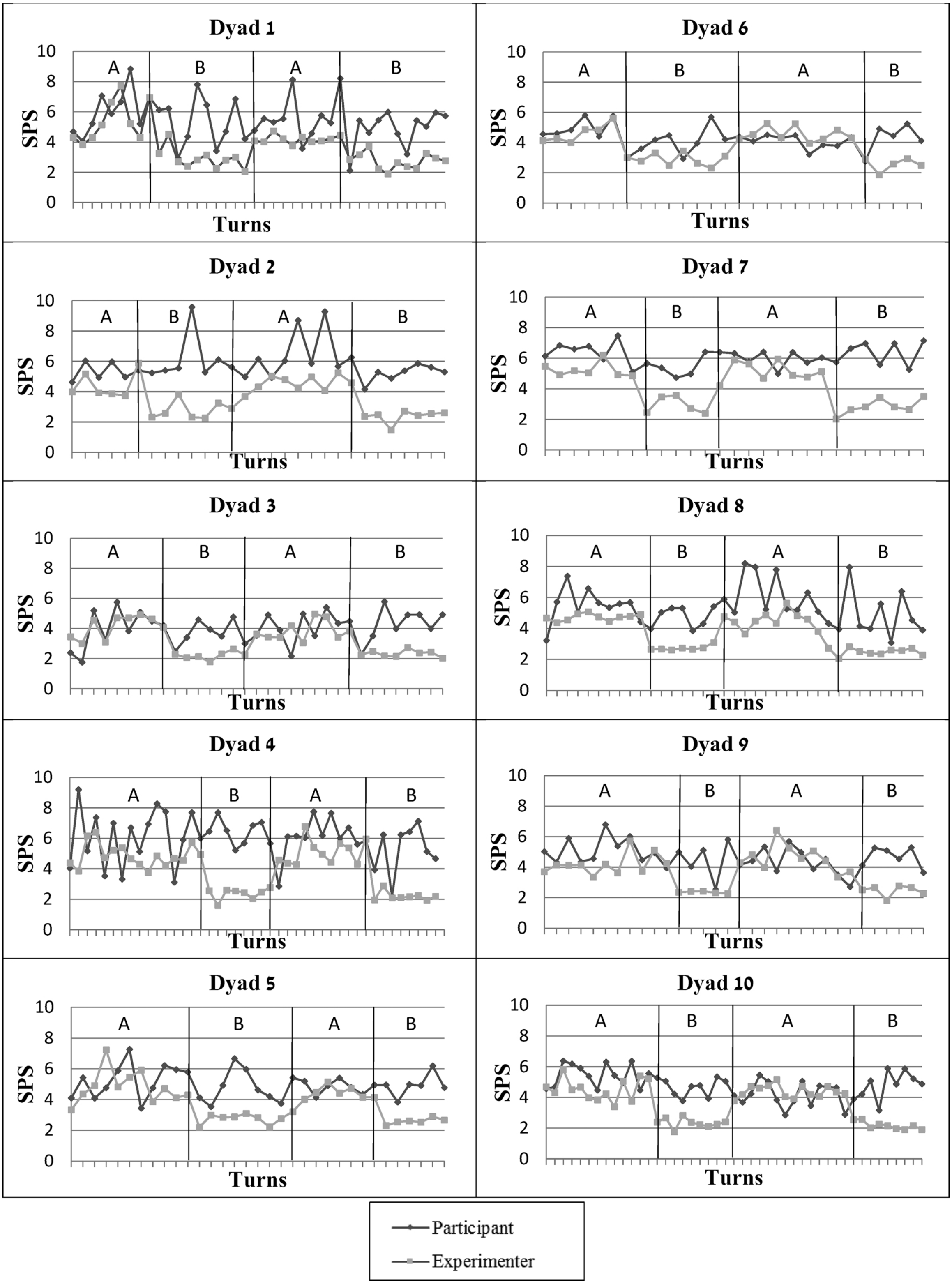


**Fig. 2.** Experimenters' and participants' speech rate arranged by turns, within the ten dyads.

agreement with these reports, despite the fact that they were conducted on children, whereas our study was conducted on adults. This is interpreted as a demonstration that speech rate adjustment is not a simple reflection of the partner's speech rate. Instead, it shows that in order to induce a relatively small reduction in speech rate, the experimenter (or the speech-therapist, in other settings) may provide a model of a more noticeable reduction in speech rate than the intended target reduction. Clearly, future research should examine this phenomenon directly, as well as its underlying mechanism, prior to providing a clinical recommendation in this direction.

The third finding of the present study was that, within the slow speech rate condition (condition B), a *negative* correlation was observed between the experimenters' and participants' speech rates. This indicates that, when examining the slow speech rate condition as a separate condition, the participants *increased* their speech rate in response to the experimenters' reduction in speech rate. This finding may be surprising, in light of the first two findings of our study, which were in agreement with previous reports. On the other hand, this result resembles the findings of Meyers and Freeman (1985), who reported that mothers spoke faster to children-who-stutter than to children-who-do-not-stutter. They suggested that this might have resulted from an uncomfortable feeling or impatience experienced by the mothers, while talking to a CWS, which have led to an increase in their speech rate. Along the same line, we suggest that during the slow rate condition, our participants felt a need to accelerate their speech rate, in order to compensate for the "time loss" owed to the experimenters' slow speech rate. This may also suggest that speech rate adjustment is not a linear phenomenon. Instead, it is argued that, indeed, during a conversation conducted at a "natural" speech rate, a positive correlation is expected between the speech rates of the two conversation partners. However, when the conversation is conducted at a slower-than-normal speech rate, as a baseline; speakers might react differently to the additional reduction in speech rate. This could lead to a specific "paradoxical" condition, in which conversation partners *increase* their speech rate in response to their partner's excessively slow speech rate. Due to the novelty of this hypothesis, further research and replication of this finding is needed for confirmation.

A few additional methodological issues should be considered. First, as noted in the results section, the mean habitual speech rate exhibited by the experimenters was slightly slower than that of the participants (4.60 versus 5.30 SPS, respectively). It is assumed that these differences are of limited clinical value. This is attributed to the fact that both values are well within the normal speech rate expected for Hebrew speakers (e.g., Amir, 2016). Moreover, our study focused on the impact of *slowing down* speech rate, rather than on the absolute values of speech rate per se. While our study demonstrated that slowing down the experimenters' speech rate impacts that of the participants, future studies could examine the direct role of speech rate, by itself, on speech rate convergence.

Second, due the preliminary nature of our study, we examined only communication dyads in which the experimenters were women and the participants were men. This methodological decision was taken in light of previous reports that have shown that female-male dyads are more likely to exhibit speech rate convergence (Street, 1984), and that habitual speech rate among Hebrew speakers is not gender dependent (e.g., Amir, 2016). Future research may examine the effect of different gender combinations within the communication dyads on speech rate convergence.

Third, our study was designed to follow the Guitar and Marchinkoski (2001) study. As such, it implemented the A-B-A-B paradigm across all dyads. In other words, habitual speech rate always preceded slow speech rate. This could have caused a possible bias of order effect. Future studies may examine speech rate convergence using additional orders of presentation, such as B-A-B-A or A-B-B-A.

In conclusion, this study examined speech rate adjustment in adults. Specifically, we studied the influence of experimenters' speech rate modification on the speech rate of their communication partners. Results confirmed that, in general, a reduction in the speech rate of one speaker, leads to a reduction in speech rate of the communication partner. However, the magnitude of the reduction is not symmetrical between the two communication partners. Results also revealed that speech rate adjustment is dependent on the setting. Specifically, different adjustment patterns were found in "normal" compared to "slow" speech rates. These findings could have direct implications for clinicians who attempt to modify their clients' speech rate. Results demonstrate that modeling slow speech is, indeed, an effective approach. However, under specific conditions, this approach could defy its purpose, when the conversation is conducted at a generally slow speech rate. Therefore, it is suggested that the slow rate modeling approach should be practiced selectively, considering its specific limits and the conversation settings.

## Acknowledgements

The authors thank Ms. Dafna Israeli and Ms. Sharon Rosenwasser for their part in data collection, Dr. Ilan Rosiner for statistical analysis and supervision, and Ms. Marlene Erez for assistance in proofreading and editing.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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**Dr. Debora Freud** is a speech-language pathologist and a visiting teacher at the Department of Communication Disorders, Tal Aviv University. She is also visiting teacher at Ariel University of Samaria. She works as a speech-language pathologist at the Speech and Hearing Center, Sheba Medical Center, Tel Hashomer, Israel.

**Dr. Ruth Ezrati-Vinacour** is a Senior Teacher at the Dept. of Communication Disorders, Sackler Faculty of Medicine, Tel Aviv University. She also works as a speech-language pathologist at the Speech and Hearing Center, Sheba Medical Center, Tel Hashomer, Israel.

**Prof. Ofer Amir** is a speech-language pathologist. He is a professor at the Department of Communication Disorders, Sackler Faculty of Medicine, Tel-Aviv University (see: https://med.tau.ac.il/profile/oferamir). He is also a practicing clinician in the fields of stuttering and speech fluency, as well as voice and its disorders (see: www.oferamir.co.il)