

*Private Speech in Illiterate Adults:
Cognitive Functions, Task Difficulty, and
Literacy*

**David Alarcón-Rubio, José A. Sánchez-
Medina & Adam Winsler**

Journal of Adult Development

ISSN 1068-0667

Volume 20

Number 2

J Adult Dev (2013) 20:100-111

DOI 10.1007/s10804-013-9161-y

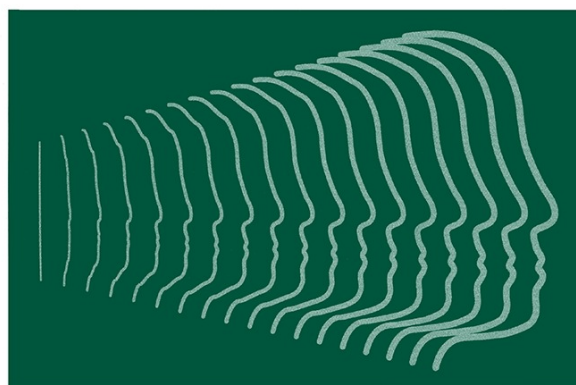
VOLUME 20, NUMBER 2

JUNE 2013

20(2) 63-112 (2013)

ISSN 1068-0667

**Journal of
Adult
Development**



 Springer

Available
online
www.springerlink.com

 Springer

Your article is protected by copyright and all rights are held exclusively by Springer Science +Business Media New York. This e-offprint is for personal use only and shall not be self-archived in electronic repositories. If you wish to self-archive your article, please use the accepted manuscript version for posting on your own website. You may further deposit the accepted manuscript version in any repository, provided it is only made publicly available 12 months after official publication or later and provided acknowledgement is given to the original source of publication and a link is inserted to the published article on Springer's website. The link must be accompanied by the following text: "The final publication is available at link.springer.com".

Private Speech in Illiterate Adults: Cognitive Functions, Task Difficulty, and Literacy

David Alarcón-Rubio · José A. Sánchez-Medina · Adam Winsler

Published online: 6 June 2013
© Springer Science+Business Media New York 2013

Abstract Children's private speech has been widely studied among children, but it is clear that adults use private speech as well. In this study, illiterate adults' private speech during a "school-like" task was explored as a function of literacy level and task difficulty in a sample of 126 adults enrolled in a public literacy program. A main effect for literacy level was found—private speech was more internalized and less externalized among adults with higher literacy levels. Externalized private speech was more frequently observed among illiterate adults engaged in the most difficult task. Private speech served cognitive functions as indicated by the proportion of self-regulatory private speech and the proportion of private speech preceding actions being higher in the advanced literacy group and among illiterate adults doing the easier task. Internalized private speech, self-regulatory private speech, and private speech preceding action were each positively correlated with performance and negatively correlated with time to complete the task. The use of private speech in illiterate adults appears to be linked to the mastery of cultural experiences, such as literacy, similar to the self-talk of children.

Keywords Illiterate adults · Private speech · Self-regulation · Internalization · Task difficulty · Literacy

D. Alarcón-Rubio (✉) · J. A. Sánchez-Medina
Department of Social Sciences, Universidad Pablo de Olavide de Sevilla, Carretera de Utrera, Km. 1, 41013 Sevilla, Spain
e-mail: dalarub@upo.es

J. A. Sánchez-Medina
e-mail: jasanmed@upo.es

A. Winsler
George Mason University, Fairfax, VA 22030-4444, USA
e-mail: awinsler@gmu.edu

Introduction

Private speech refers to overtly vocalized speech that is not addressed to anyone other than the speaker (Goudena 1987). According to Vygotsky's developmental theory, private speech has an important role in the development of higher-cognitive process (Vygotsky 1934/1986). Vygotsky argued that private speech helps the child to regulate ongoing cognitive activity. This type of self-regulatory speech is assumed to be an intermediate step between external social tools for regulating the child's behavior and the soundless verbal thought, defined as inner speech (Berk and Winsler 1995; Fernyhough and Fradley 2005). From this perspective, Vygotsky hypothesized that private speech would show a curvilinear developmental pattern, peaking in the early school years and then decreasing as regulation becomes increasingly internalized (Winsler 2009).

In Vygotsky's (1934/1986) theory of cognitive development, private speech is produced by the progressive functional differentiation of language, from communicative to self-regulatory functions (Berk 1986; Goudena 1987; Winsler et al. 1997). This means that private speech arises originally due to a lack of functional differentiation between speech for others and speech for oneself. This lack of differentiation will go on for some time but then disappear with development. That is, at a certain developmental stage, the child will clearly differentiate between two functions: social-communicative speech oriented to others and internal self-oriented speech directed at the self. At this point, private speech is seen as disappearing, "going underground" (Vygotsky 1934/1987), or being transformed into inner speech.

Private speech has been widely studied during the last three decades (Winsler 2009). Most of the Vygotsky's

hypothesis about private speech in child development has been supported by the studies. Private speech has been observed as early as 23–25 months of age (Furrow 1984) and as late as 17 years (Winsler and Naglieri 2003; Winsler et al. 2006). In general, child use of private speech increases with age, peaks around 4 or 5 years old, and gradually becomes more abbreviated until it is internalized around the age of 7 or 8 years (Behrend et al. 1989; Berk 1986, 1992; Manning et al. 1994; Quay and Blaney 1992).

However, private speech continues to be used by adolescents and adults periodically as well as a tool for self-regulation (Fry 1992; John-Steiner 1992). Winsler and Naglieri (2003) have shown that 10–30 % of children aged from 11 to 17 still spontaneously used fully overt self-talk during a cognitive task. Kronk (1994) documented private speech use by adolescents while they wrote an exam. More interesting data are provided by Duncan and Cheyne (1999), who, using a self-report questionnaire administered to 1,132 undergraduate university students, found high levels of reported self-verbalization for the regulation of various cognitive processes. Furthermore, Duncan and Cheyne (2002) observed private speech in young adults while working on tasks of varying difficulty. Young adult's private speech was sensitive to experimental manipulations just as has been shown in research with children, suggesting contextual and functional similarities across age.

These findings are consistent with Vygotsky's general cultural–historical framework and his claim that human psychological processes become verbally mediated. Private speech use in adults indicates that overt self-verbalization continues to play a mediational role in problem-solving and self-regulatory processes during adulthood (Duncan and Cheyne 2002; Sanchez et al. 2009). John-Steiner (1992) pointed out that private speech may come back after becoming internalized when adults need to complete novel or difficult tasks. Lantolf and Frawley (1984) found, using a picture narration task, that the use of private speech was common in adults who are learning a second language (L2). Other studies have shown that adults often use private speech as a tool for self-regulation in L2 collaborative contexts and that the use of private speech by second language learners decreases with increases in L2 proficiency and as task difficulty decreases (Antón and DiCamilla 1998; DiCamilla and Antón 2004; Frawley and Lantolf 1985; McCafferty 1992, 1994). Centeno-Cortés and Jimenez (2004) studied the private speech of adults with different levels of mastery in the Spanish language (native, advanced, and intermediate speakers). They asked participants to solve cognitively challenging problem-solving tasks in Spanish. Spanish native speakers used PS only in their native language (L1), while nonnative Spanish speakers employed PS both in their L1 and L2. Furthermore, intermediate and advanced nonnative Spanish speakers employed PS

differently. Those with intermediate proficiency levels used PS mainly when reading or when repeating parts of questions, while those with advanced proficiency levels used PS to guide their reasoning. These data show that the frequency of PS use among adults is related not only with proficiency in L2, but also with self-regulatory functions (McCafferty 1994).

The use of private speech in children and adults may reflect localized knowledge based on particular cultural experiences and the mastery of particular cultural tools, such as literacy. Several studies have found that children from different cultural backgrounds and socioeconomic strata use different frequencies of private speech when faced with a school-like task (Berk 1986; Quay and Blaney 1992). Furthermore, studies of adults learning a second language (L2) show that L2 proficiency influences the use of private speech (Centeno-Cortés and Jimenez 2004; Lantolf and Frawley 1984). Thus, adults' private speech is hypothesized to change as a temporary function of experiential conditions, such as task difficulty, context familiarity, and literacy proficiency. In this paper, we examine private speech production among adults who vary in levels of literacy and relate such findings to what is known about self-speech in young children. We ask whether the use of private speech in illiterate adults is related to their individual experiences with literacy and difficulty within a certain cultural setting such as performing an academic task. We expected the illiterate adults to produce a valuable amount of private speech during the task. Our hypotheses were that (a) adults with limited literacy doing a classification task would use more externalized forms of private speech and less internalized forms of private speech compared to adults with greater literacy (Centeno-Cortés and Jimenez 2004; McCafferty 1994); (b) with increasing difficulty, more externalized private speech and less internalized private speech would be seen (Duncan and Cheyne 2002; John-Steiner 1992); (c) self-regulatory private speech and private speech that precedes action would be more likely to occur in the advanced literacy group, and on the easier task (Antón and DiCamilla 1998; DiCamilla and Antón 2004); and (d) internalized private speech, self-regulated private speech, and private speech preceding action would be positively correlated with performance and negatively correlated with time to complete the task (Winsler and Naglieri 2003; Winsler et al. 2006).

Method

Participants

A total of 126 Spanish-speaking adults, 103 women (82 %), enrolled in a literacy educational program (mean

age = 54.7 years; range = 25–65; SD = 7.78) in the south of Spain served as participants in this study. The literacy program attended by the adults is divided into three literacy levels: (1) low—directed to people who still need to learn to read and write; (2) intermediate—directed to people who can read and write at a very basic level but who have very limited education and knowledge about scholarly subjects (e.g., history, math); and (3) advanced—directed to adults who are improving their scholarly knowledge to work toward acquiring an accredited certificate.

Materials

Semantic tasks, such as classifying objects, have been used effectively in the private speech literature with children to obtain samples of private speech (Berk 1986; Diaz 1992; Frauenglass and Diaz 1985; Goudena 1987). Previous studies have frequently observed a greater percentage of private speech in school-like activities than during other activities, or free-play (Berk and Garvin 1984; Kraft and Berk 1998; Matuga 2003; Winsler et al. 2000; Winsler and Diaz 1995). As the main objective of our study was to see whether illiterate adults produce similar patterns of private speech than those often seen in studies with children, we selected a school-like task because this is the most widely task used in child studies of PS (Winsler 2009; Winsler et al. 2005). We also wanted the task to be novel to the participants since more use of PS has been observed on new as opposed to familiar tasks (Azmitia 1992; Diaz 1992). The private speech used by individuals in real life likely parallels that used in experimental situations in that PS is most likely to appear during challenging problem-solving situations. Observational studies of children in “real-life” classrooms also confirm that naturalistically, such speech occurs when the individual is engaged in challenging goal-directed activity (Winsler 2009). The task used here consisted of a frame (seven rows and five columns) where 35 pictures of objects could be placed/classified into 5 categories (animals, furniture, musical instruments, tools, and vehicles). The pictures were in a bin and participants had to pick up a card and attach it to the frame with Velcro.

Adults were videotaped while they completed the task in pairs (each completed their own frame/pictures) in a separate testing/meeting room at the school. A digital camcorder and a remote Pressure Zone Microphone (PZM) were used to record the session. The video camera was mounted on a tripod approximately 12 feet away from the dyad facing them in front as they were seated at a table with two sets of task materials. The experimenters sat next to the dyad at the table during the instruction part of the task and moved his chair over to the side end of the table and looked away during the individual part of the task.

Adobe Premier 6.0 software was used to digitize the videos and sound track. The Transana software was used to make the transcriptions and The Observer Video-pro (NOLDUS) software was used to code. Analyses were done by SPSS v.16.0 software.

Procedure

Experimental Tasks

The study included two between-subjects experimental variables—literacy level of participants (low, intermediate, advanced) and task difficulty (easy, intermediate, difficult). It has been widely observed that private speech rates increase with the difficulty level of the task (Antón and DiCamilla 1998; Behrend et al. 1989; Duncan and Cheyne 2002; Fernyhough and Fradley 2005). In our study, the difficulty levels of the task were designed based on a pilot study with illiterate adults, comparing the effect of the number of cards to order and the number of cards left as examples in a categorization task (Sanchez and Alarcón 2006). For the easy version of the task, two examples of each of the five categories were already placed in the framework and they had to finish categorizing the remaining 25 cards. In the intermediate condition, the process was the same but only one example of each category was pre-placed and participants had to classify the remaining 30 cards. For the difficult condition, there were no pictures placed ahead of time in the frame and participants had to place all 35 cards and start the columns themselves.

Within each literacy level group, participants were assigned randomly to work in pairs. The pairs were likely somewhat familiar with each other because they were classmates. The dyads of each literacy level were randomly assigned to one of the three tasks varying in difficulty, resulting in 7 dyads (14 adults) for each literacy level × difficulty task group. Previous studies, both with children (Azmitia 1992; Behrend et al. 1989; Furrow 1984; Kraft and Berk 1998; Winsler and Diaz 1995; Winsler et al. 1997) and with adults (Antón and DiCamilla 1998; DiCamilla and Antón 2004), clearly show that individuals do engage in private speech in the context of dyadic interaction and that PS is rather easily distinguished from social speech even when others are present (Winsler et al. 2005). These studies also show that the form and function of PS is the same when alone or with others, but that the *amount* of private speech used in dyadic situations can be more or less than that used when alone, depending on whether the other present is directing the child's problem-solving activities. In our pilot work (Sanchez and Alarcón 2006), it was determined not only that participants felt more comfortable engaging in the novel academic-like task with another peer

in the room, but that private speech was easily discernable in this semi-social situation.

The experimental task was explained to the dyad, but each one performed their own task, sitting at nearby tables in front of the camera. They were allowed to talk to each other if desired but were not allowed to pick up pieces of the other person's sorting cards. Participants were told a cover story about the purpose of the study, hiding the observational purpose of spontaneous speech.

Transcription and Coding Speech

Participants' speech while working on the experimental tasks was transcribed into utterance units on the basis of temporal isolation from other speech. A verbalization was considered a discrete utterance unit if the participant did not speak for at least 2 s before and after the verbalization (Furrow 1984). Video and audio synchronization was assisted by Transana software, and careful transcription was completed by research assistants. Two research assistants, blind to the hypotheses, received training in private speech coding procedures using the Observer Video-pro software. To examine inter- and intra-judge agreement, a sample was chosen randomly and coded by both observers.

Measures

Adult speech utterances were classified as either social or private, with private speech being defined as any verbalization by the subject which was not explicitly addressed to another person, as indicated by either a pronoun reference, a gaze to another person, or other signals of social intent, such as physical contact, argumentation, repetition, loudness/intonation, or conversational turn-taking (Winsler 1998; Winsler et al. 1997). Speech utterances during problem solving were classified according to Berk's (1986) coding system which categorizes children's private speech utterances on the basis of overtness (volume) and task-relevance and consists of three broad categories. We coded private speech utterances within two different categorization systems, first by overtness: (1) externalized private speech, consisted of all regular-volume utterances; and (2) partially internalized private speech, include low-volume utterances, inaudible muttering, whispers, and silent verbal lip movements. The percentage of utterances in each category over the total number of private speech utterances was calculated. To control for differences in the amount of time that adults took to complete the task, in addition to the percentage of utterances, utterances per minute for each speech category were calculated.

The function of the private speech was classified based on the semantic content and position of the speech over the action (Winsler et al. 2005). The classification system of

private speech by semantic content was as follows: (a) private speech not relevant to the task, when the content of a statement was not related to the action or task (e.g., "I took a bus today"); (b) self-regulatory private speech, understood as any statement relevant to the task or action, or a description of the material or an indication of where a card would go (e.g., "This one over there"); and (c) reinforcing/evaluating private speech, when any statement expressed an assessment, positive or negative, on the outcome of the action or the course of the task (e.g., "I am doing well!"). The classification system of speech by its temporal position was as follows: (a) private speech preceded action if vocalization began prior to picking a card, or alternatively, (b) private speech not-preceding action, if the vocalization began after picking a card, or if the utterance occurred concurrently with the action of placing a card on the board. The percentage of utterances over total private speech was calculated for each category of the functional coding systems.

Two trained research assistants completed coding. To assess reliability, the two researchers coded 20 % of the transcripts used in the present analyses separately. Assigned codes for each unit of speech were compared and the average kappa was calculated for each behavior. The average kappas for the coding of speech behaviors ranged from .73 (externalized PS) to .87 (social PS). These kappas range from "substantial" to "excellent" (Landis and Koch 1977).

Total task performance was estimated by assessing each of the pieces that the adults had to place in the frame. Adults' final performance score therefore could range from 0 to 25 on the easier task, to 30 on the middle difficult task, and to 35 on the harder task. The percentage of correct cards placed over the total possible was calculated.

Because participants were grouped in pairs, there was the possibility of dependency existing between the data produced by the two people involved in the pair, which would violate the independence assumption of our statistical procedures. To test for this, we calculated intra-class correlation coefficients (ICCs) according to the procedures by Alferes and Kenny (2009) and conducted significance tests for dependence with a partially nested design with two crossed factors between-subject (literacy \times difficulty), with dyad as a nesting variable (Zhou et al. 2011) for all the social and private speech measures. Interestingly, the ICCs were sizeable only for the social speech measures [(ICC = .34, $F(54) = 2.01$, $p < .01$) for social speech per minute, and ICC = .12, $F(54) = 1.28$, $p = .34$ ns. for proportion social speech]. As is expected, the amount of social speech of one individual in a dyad is related to the amount of speech by the other person in the dyad. However, importantly, the ICCs were trivially small and non-significant for all the private speech measures, ranging

from .01 to .07, indicating that there was functional independence across members in the dyads in terms of the adults' private speech use. We therefore proceeded with our regular (as opposed to nested) ANOVAs discussed below.

Results

Task Performance and Time

Performance scores and minutes to complete the task were analyzed as the dependent variables using a 3 (educational level) × 3 (difficulty) analysis of variance (ANOVA), and the results are provided in Table 1. The percentage of correct items was higher in the advanced literacy group, $M = 98.21$, $SD = 2.65$, than in the intermediate group, $M = 92.14$, $SD = 6.34$, and the basic literacy group, $M = 82.75$, $SD = 7.77$, $F(2,126) = 67.27$, $p < .01$. Percentage correct was higher for the easier task, $M = 95.71$, $SD = 5.33$, than on the medium, $M = 91.42$, $SD = 7.1$, and the more difficult task, $M = 85.91$, $SD = 10.54$, $F(2,126) = 19.98$, $p < .01$. The analyses of time (in minutes) used to complete the task indicated that the basic literacy group were slower, $M = 8.61$, $SD = 2.75$, than the intermediate group, $M = 5.47$, $SD = 1.19$, and the advanced literacy group, $M = 5.57$, $SD = 1.45$, $F(2,126) = 36.31$, $p < .01$. All groups were faster on the easier task, $M = 4.81$, $SD = 1.15$, than on the medium, $M = 7.66$, $SD = 2.17$, and difficult task, $M = 7.19$, $SD = 2.6$, $F(2,126) = 23$, $p < .01$. There was not an interaction between literacy level and difficulty level on performance or time to completion. A Pearson correlation between percentage correct and the amount of time in minutes to complete the task indicated that participants with better performance were faster to complete the task, $r = -.64$, $p < .01$.

Private Speech Use

All 126 participants in this experiment used private speech while working on the classification task. The mean number of private speech was 40.61 utterances ($SD = 27.31$, range = 4–162). Overall, 100 % of adults produced externalized private speech ($M = 32.56$ utterances, $SD = 24.62$, range = 2–160), and 79 % of adults produced partially internalized private speech ($M = 7.96$, $SD = 9.75$, range = 0–42). Speech measures were not correlated with age, and there were no effects of gender on speech measures, Mann–Whitney U tests $< .9$, ns . Data generated with the speech coding systems were analyzed as the dependent variable using a 3 (educational level) × 3 (difficulty) analysis of variance (ANOVA), and the results are provided in Table 2. There were main effects of literacy level and

Table 1 Means (and standard deviations) of performance scores and time in minutes by literacy level and task difficulty

Literacy level × Task difficulty	Basic			Intermediate			Advanced		
	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)
Minutes to complete the task	5.29 (1.43)	10.14 (1.23)	10.43 (1.15)	4.71 (.91)	6.43 (1.22)	5.29 (.72)	4.43 (.94)	6.43 (1.34)	5.86 (1.29)
Proportion of correct items	89.71 % (4.35)	83.10 % (4.02)	75.31 % (6.59)	97.71 % (3.02)	93.81 % (3.89)	84.90 % (5.53)	99.71 % (1.06)	97.38 % (2.97)	97.55 % (2.93)

Table 2 Means (and standard deviations) of observed speech measures (utterances per minute and percentages) by literacy level and task difficulty

Literacy level × Task difficulty Measure	Basic			Intermediate			Advanced		
	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)
Social speech per minute	6.21 (6.66)	2.49 (1.45)	.64 (.32)	4.83 (3.11)	4.46 (2.61)	2.36 (.75)	3.12 (2.55)	4.12 (2.72)	4.29 (3.6)
Percentage of SS (over total speech)	.40 (.18)	.37 (.18)	.30 (.14)	.33 (1.16)	.39 (.11)	.35 (.11)	.26 (.16)	.39 (.16)	.32 (.14)
Externalized PS per minute	7.78 (6.88)	4.56 (2.84)	1.55 (.83)	7.39 (4.49)	5.69 (3.31)	4.74 (3.03)	5.3 (3.78)	4.66 (2.92)	7.31 (5.41)
Perc. of external PS (over total speech)	.48 (.19)	.59 (.21)	.67 (.16)	.50 (.22)	.49 (.10)	.61 (.12)	.41 (.18)	.46 (.15)	.52 (.13)
Internalized PS per minute	1.71 (1.71)	.27 (.32)	.03 (.10)	2.15 (1.36)	.89 (.93)	.33 (.40)	5.02 (4.08)	1.58 (1.42)	1.82 (1.54)
Perc. of internal PS (over total speech)	.12 (.11)	.04 (.04)	.02 (.04)	.16 (.12)	.11 (.12)	.04 (.04)	.32 (.19)	.15 (.08)	.15 (.11)

SS = Social Speech, PS = Private Speech

task difficulty on the different speech categories. The lower literacy level group produced less partially internalized private speech than both other groups, $F(2, 126) = 17.73, p < .01, \eta_p^2 = .233$. The effect of literacy level was non-significant for the rate of social speech per minute, $F(2, 126) = .78, p = .46, \eta_p^2 = .013$, and the rate of externalized private speech per minute, $F(2, 126) = 1.29, p = .28, \eta_p^2 = .022$. As Fig. 1 shows, in the advanced literacy group, the proportion of externalized private speech was less, $F(2, 126) = 4.92, p < .01, \eta_p^2 = .078$, while the proportion of internalized private speech was higher, $F(2, 126) = 21.65, p < .01, \eta_p^2 = .267$. There were no significant differences in the proportion of social speech by literacy level, $F(2, 126) = .94, p = .39, \eta_p^2 = .016$.

Task difficulty had a significant effect on adults' rate of social speech. As seen in Table 2, adults talked less socially between them when they were doing the more difficult task, $F(2, 126) = 5.47, p < .01, \eta_p^2 = .086$. The rates of externalized and internalized private speech per minute were higher while they were working on the easy task, $F(2, 126) = 3.77, p = .02, \eta_p^2 = .061$, and $F(2, 126) = 21.43, p < .05, \eta_p^2 = .268$, respectively. As Fig. 2 shows, the proportion of externalized private speech was

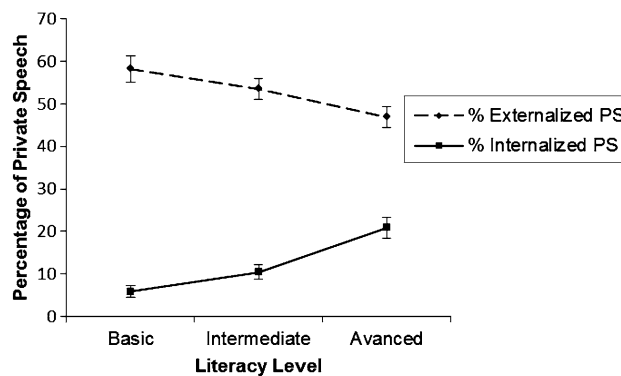


Fig. 1 Percentages of social speech and private speech by literacy level. Error bars represent the standard error of the mean

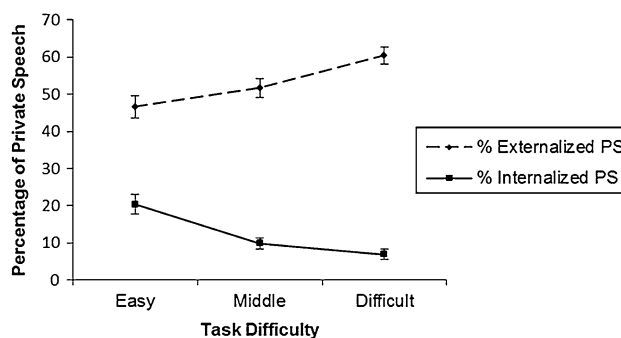


Fig. 2 Percentages of social speech and private speech by task difficulty level. Error bars represent the standard error of the mean

higher on the difficult task, $F(2, 126) = 7.36, p < .01, \eta_p^2 = .118$, while internalized private speech was less common, $F(2, 126) = 18.57, p < .01, \eta_p^2 = .24$. There was no difference in the proportion of social speech by task difficulty, $F(2, 126) = 2.13, p = .12, \eta_p^2 = .035$.

The interaction between literacy level and task difficulty was significant for adults' rate of social speech per minute, $F(2,125) = 4.36, p < .01, \eta_p^2 = .13$, and the rate of externalized private speech, $F(2,125) = 3.82, p < .01, \eta_p^2 = .116$. Adults with basic and intermediate literacy levels used more frequent social speech and externalized private speech than adults with advanced literacy, but the advanced adults (compared to the other literacy groups) used higher rates of social speech and externalized private speech on the more difficult task (see Table 2). The interaction between literacy level and task difficulty was nonsignificant for adults' rate of internalized private speech per minute, $F(2, 126) = 1.81, p = .13, \eta_p^2 = .058$. There were no interaction effects between literacy level and task difficulty on percentage of adults' social speech, $F(2, 126) = 1.43, p = .23, \eta_p^2 = .047$; the percentage of externalized private speech, $F(2, 126) = .62, p = .65, \eta_p^2 = .021$, nor the percentage of internalized private speech, $F(2, 126) = 1.22, p = .31, \eta_p^2 = .04$.

Pearson correlations between the proportional speech categories and performance and time were analyzed. The percentage of speech that was social was not correlated with performance, $r = .03$, nor with time spent, $r = -.06$. The proportion of private speech that was externalized was negatively associated with performance, $r = -.38, p < .01$, and positively correlated with the amount of time to complete the task, $r = .38, p < .01$. Proportion of internalized private speech was positively associated with performance, $r = .47, p < .01$, and negatively correlated with the time to complete the task, $r = -.42, p < .01$.

Private Speech Function

Almost all (97 %) of the private speech utterances coded above also fell into one of the three private speech functional categories. Data generated from the private speech functional coding systems were also analyzed as dependent variables using a 3 (educational level) \times 3 (difficulty) ANOVA, and the results are provided in Table 3. The advanced literacy group produced less irrelevant private speech than both other groups, $F(2, 126) = 16.13, p < .01, \eta_p^2 = .216$, but the advanced literacy group used proportionally more self-regulatory private speech, $F(2, 126) = 5.46, p < .01, \eta_p^2 = .085$, and reinforcing private speech, $F(2, 126) = 8.78, p < .01, \eta_p^2 = .131$, see Fig. 3.

As Fig. 4 plots, the proportion of irrelevant private speech was less on the easier task, $F(2, 126) = 36.07, p < .01, \eta_p^2 = .381$, while the proportion of self-regulatory

Table 3 Means (and standard deviations) for private speech function measures (percentages over total private speech) by literacy level and task difficulty

Literacy level \times Task difficulty	Basic			Intermediate			Advanced		
	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)	Easy Mean (SD)	Middle Mean (SD)	Difficult Mean (SD)
Perc. of irrelevant PS (over total PS)	.13 (.16)	.53 (.24)	.79 (.15)	.29 (.17)	.37 (.14)	.57 (.12)	.27 (.13)	.34 (.12)	.22 (.18)
Perc. of self-regulatory PS (over total PS)	.74 (.19)	.41 (.26)	.16 (.14)	.58 (.14)	.53 (.13)	.34 (.16)	.64 (.15)	.48 (.17)	.56 (.16)
Perc. of reinforcing PS (over total PS)	.14 (.08)	.06 (.06)	.04 (.04)	.13 (.12)	.09 (.07)	.08 (.08)	.09 (.09)	.17 (.10)	.21 (.08)
Perc. of PS preceding action (over total PS)	.43 (.19)	.54 (.23)	.51 (.13)	.71 (.21)	.43 (.24)	.45 (.17)	.71 (.20)	.42 (.07)	.46 (.20)

PS Private Speech

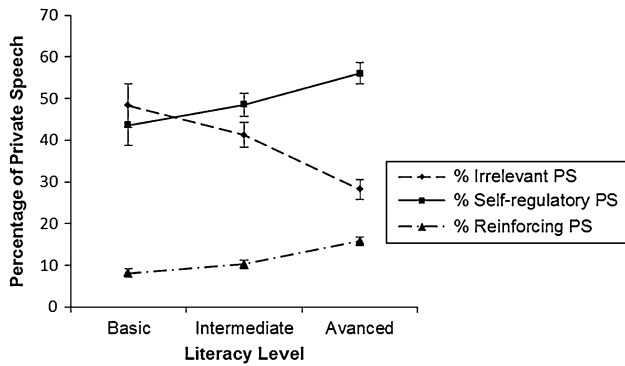


Fig. 3 Proportion of irrelevant, self-regulatory, and reinforcing private speech by literacy level. *Error bars* represent the standard error of the mean

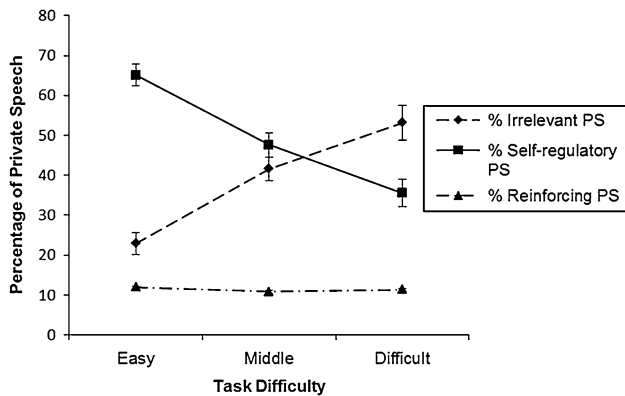


Fig. 4 Proportion of irrelevant, self-regulatory, and reinforcing private speech by task difficulty. *Error bars* represent the standard error of the mean

private speech was higher, $F(2, 126) = 30.9, p < .01, \eta_p^2 = .346$. There was not a main effect of task difficulty on the percentage of reinforcing private speech, $F(2, 126) = .19, p = .83, \eta_p^2 = .003$. The interaction between literacy level and task difficulty effect was significant for the percentage of irrelevant private speech, $F(2,125) = 17.77, p < .01, \eta_p^2 = .378$, the percentage of self-regulatory private speech, $F(2,125) = 8.92, p < .01, \eta_p^2 = .234$, and the percentage of reinforcing private speech, $F(2,125) = 6.48, p < .01, \eta_p^2 = .181$; see Fig. 5. There was an increasing linear trend for the percentage of irrelevant private speech in the basic and intermediate literacy groups when they were performing the more difficult task, while there was a declining linear trend for the percentages of self-regulatory and reinforcing private speech in those literacy groups when they were doing the more difficult task. Finally, since the categories of private speech might be related to one another, we also verified that the above-reported results were similarly obtained when all of the functional PS category variables were added together as related DVs in a two-way (literacy level \times task difficulty) MANOVA.

Analyses of data generated using the binary coding system for private speech by position relative to action (see Table 3) indicated that there was no effect of literacy group on the percentage of private speech that preceded action, $F(2, 126) = .45, p = .64, \eta_p^2 = .008$. There was a main effect of difficulty, $F(2, 126) = 8.88, p < .01, \eta_p^2 = .132$, and a literacy \times difficulty interaction, $F(2, 126) = 5.8, p < .01, \eta_p^2 = .167$. The percentage of private speech

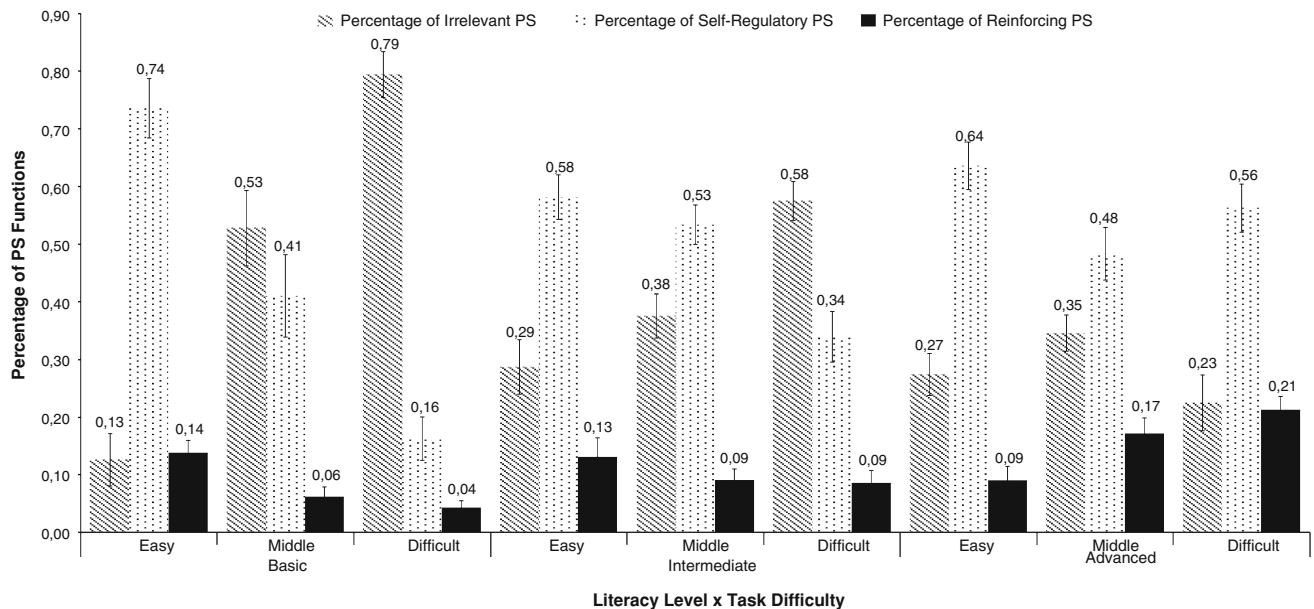


Fig. 5 Proportion of irrelevant, self-regulatory, and reinforcing private speech by literacy level and task difficulty. *Error bars* represent the standard error of the mean

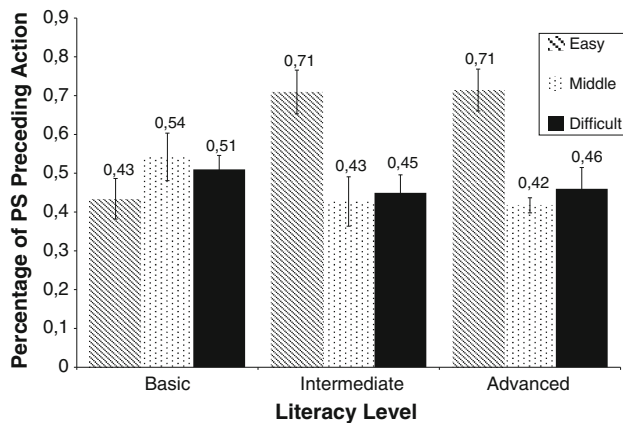


Fig. 6 Proportion of private speech preceding action by literacy level and task difficulty. *Error bars* represent the standard error of the mean

preceding action was higher on the easier task but only in the intermediate and advanced literacy groups; see Fig. 6.

Finally, Pearson correlations between the private speech functions and performance and time were also analyzed. The percentage of irrelevant private speech was negatively correlated with performance, $r = -.58$, $p < .01$, and positively correlated with time to completion, $r = .51$, $p < .01$. The percentage of self-regulatory and reinforcing private speech was positively correlated with performance, $r = .51$, $p < .01$, and $r = .27$, $p < .01$, respectively, and negatively correlated with the time, $r = -.46$, $p < .01$, and $r = -.22$, $p = .01$, respectively. The percentage of private speech preceding action was positively correlated with performance, $r = .28$, $p = .05$, and not correlated with time to complete the task, $r = -.09$.

Discussion

It is notable that much private speech was produced by the adults from all literacy levels in this study. Our main argument at this point is that private speech in illiterate adults appears to respond to similar variables, such as task difficulty, that have been found in private speech research with children. The results of the analyses support in a clear way our starting hypothesis. The most externalized verbal tools of regulation—social speech and externalized private speech—were less frequent in the advanced literacy group. The trend for internalized private speech was the reverse—this form of private speech was more frequent in the higher literacy level group. Similar trends have been widely observed in children related to age (Behrend et al. 1989; Winsler et al. 1997). Our data on the role of task difficulty in illiterate adult private speech production reproduce the same pattern that has been systematically observed in samples of children (Azmitia 1992; Behrend et al. 1989;

Manning et al. 1994): Higher levels of internalized private speech production are observed with increased competence, while greater externalized private speech is found on more difficult tasks.

Analyses of the cognitive functions of private speech indicated, similar to other research with adults (Duncan and Cheyne 2002), that self-regulatory and reinforcing private speech were more likely in the advanced literacy group and on the easier task. Further, there were high positive correlations between task performance and internalized private speech, self-regulatory private speech and private speech preceding action, with those speech categories also being negatively correlated with how long it took participants to finish the task. This finding is consistent with the Vygotskian hypothesis of the progressive differentiation of speech functions that has been strongly supported by empirical research conducted with children (Berk and Garvin 1984; Fernyhough and Fradley 2005; Winsler et al. 2006, 2007; Winsler and Naglieri 2003).

A relevant finding was the significant interaction between literacy level and task difficulty on measures of social speech and externalized private speech. In this study, we observed that adults with basic and intermediate literacy levels tended to use less often these types of speech with increasing task difficulty, while those with advanced literacy levels increased the frequency of social speech and externalized PS with the difficulty of the task. These data should be interpreted taking into account the collaborative context in which the school-like task was completed. As researchers have noted, in social settings, both social speech and externalized PS have task and regulatory functions (Centeno-Cortés and Jimenez 2004; De Guerrero 1994, 2004; McCafferty 1994). Other studies have pointed out the relevance of social speech in adults while working in collaborative problem-solving tasks (Dixon et al. 1997; Kimbler and Margrett 2009; Meehan and Berg 2002). In a collaborative situation, every statement, social and private, may have a regulatory role for the listener and the speaker, serving to focus the attention of the participants in the new information to solve the problem (Antón and DiCamilla 1998; DiCamilla and Antón 2004; Frawley and Lantolf 1985; Lantolf and Frawley 1984). This regulatory function of out-loud statements, social speech and private speech, would explain why the interaction effect between literacy level and task difficulty was observed for participants' social speech and externalized private speech, while the low volume partially internalized private speech, which is clearly not directed to the others, was always more frequently observed across those with higher literacy level and during lower difficult tasks. Those settings are where illiterate adults are more autonomous or self-regulated.

Summarizing, we found support for the hypothesis that illiterate adults attending literacy programs, when faced with school-like tasks, use private speech as a mean to

solve those tasks. Furthermore, the functional trends of illiterate adult private speech were very similar to that reported by private speech studies with children. Following Vygotsky (1934/1986), private speech production is a consequence of a wider process of the functional differentiation of speech. Private speech has a communicative function, due to its social origin, as well as an intellectual one, due to its fate, to become inner speech. But private speech could reappear during adulthood once the internalization process is complete during new or difficult tasks (Behrend et al. 1989; Duncan and Cheyne 2002; Kraft and Berk 1998).

From a Vygotskian perspective, the function and form of private speech are linked to the individual's social and cultural history, including the context of acquiring literacy (another cultural tool being internalized by the individual, regardless of when this takes place) where verbal self-regulating tools are useful (Berk and Winsler 1995; Rogoff 1990, 2003; Wertsch 1985, 1993). Duncan and Cheyne (2002) defend a similar argument explaining their finding of adult private speech production during computer and paper-folding tasks. That is, the ontogenetic pattern of private speech observed systematically in numerous studies corresponds to the progressive mastering of specific task resolution skills from the culture of schooling and literacy. Practically, all private speech researches use "school-like" tasks or are observed in the frame of "school-like" activities, or demand the use of skills closely related to school learning and literacy. Our hypothesis, following Duncan and Cheyne (2002), is that changes in private speech form and function patterns reflect the effect of the increasing degree of internalization and use of literacy and language for mastering school-based tasks. Our data provide strong support for this hypothesis.

One limitation of this study was the small sample size; therefore, effect sizes were provided for both significant and nonsignificant results to get an idea of whether there were reasonable effects that were not significant because of sample size. However, most of the effect sizes for the nonsignificant analyses were very small, $\eta_p^2 < .0588$ (Richardson 2011). Second, although our examination of functionally illiterate adults was a strength in that it allowed us to examine the role of private speech across adults who are just learning literacy, it also prevents us from generalizing the findings here to broader, literate adult populations, which is a limitation. Other studies have observing PS to be fairly universal, found across languages, social status, ages, behavior problems, developmental disorders, and even among deaf children (see for a review Winsler 2009). In Al-Namlah et al. (2006), for instance, PS was observed across British and Saudi Arabian children, and there were no overall differences due to nationality in use of self-talk. Our position is that the internalization of

speech is linked to the mastering of context-specific cultural skills. Adults acquiring literacy reflect universal processes of appropriation and mastering of a cultural tool (Rogoff 1990; Wertsch 1985), and it is interesting and important that we may observe changes in adults' use of private speech as well during such a process. Of course, this contextual specificity is not exclusive of the speech internalization process. Several studies have shown similar results in relation to concept formation and grouping skills, memory development, reasoning, and arguing skills (Cole and Scribner 1977; Daugherty 1993; Daugherty et al. 1994; Matuga 2003).

The findings of the current study provide important support for the Vygotskian theory of speech internalization. It is well known that the most characteristic feature of Vygotskian theory is the emphasis on the role that social interaction and culture play in psychological development. What we have found is that illiterate adults use private speech as children do, under similar circumstances, and under the control of the same variables. This research shows that private speech use and evolution may be linked to individuals' mastering in cultural tools for self-regulation linked to specific historical and cultural contexts, and not just a function of ontogenetic processes.

References

- Alferes, V. R., & Kenny, D. A. (2009). SPSS programs for the measurement of nonindependence in standard dyadic designs. *Behavior Research Methods*, *41*, 47–57.
- Al-Namlah, A. S., Fernyhough, C., & Meins, E. (2006). Sociocultural influences on the development of verbal mediation: Private speech and phonological recoding in Saudi Arabian and British samples. *Developmental Psychology*, *42*, 117–131.
- Antón, M., & DiCamilla, F. J. (1998). Socio-cognitive functions of L1 collaborative interaction in the L2 classroom. *The Canadian Modern Language Review*, *54*, 314–342.
- Azmitia, M. (1992). Expertise, private speech, and the development of self-regulation. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 101–122). London: Erlbaum.
- Behrend, D. A., Rosengren, K., & Perlmutter, M. (1989). A new look at children's private speech: The effects of age, task difficulty, and parent presence. *International Journal of Behavioral Development*, *12*, 305–320.
- Berk, L. E. (1986). Development of private speech among preschool children. *Early Child Development and Care*, *24*, 113–136.
- Berk, L. E. (1992). Children's private speech: An overview of theory and the status of research. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 17–53). London: Erlbaum.
- Berk, L. E., & Garvin, R. A. (1984). Development of private speech among low-income Appalachian children. *Developmental Psychology*, *20*, 271–286.
- Berk, L. E., & Winsler, A. (1995). *Scaffolding children's learning: Vygotsky and early childhood education*. Washington, DC: National Association for the Education of Young Children.

- Centeno-Cortés, B., & Jimenez, A. F. (2004). Problem-solving tasks in a foreign language: The importance of the L1 in private verbal thinking. *International Journal of Applied Linguistics*, *14*, 7–35.
- Cole, M., & Scribner, S. (1977). *Culture and thought*. Mexico City: Limusa.
- Daugherty, M. (1993). Creativity and private speech: Developmental trends. *Creativity Research Journal*, *6*, 287–296.
- Daugherty, M., White, S., & Manning, B. (1994). Relationships among private speech and creativity measurements of young children. *Gifted Child Quarterly*, *38*, 21–26.
- De Guerrero, M. C. M. (1994). Form and function of inner speech in adult second language learning. In J. Lantolf & G. Appel (Eds.), *Vygotskian approaches to second language research* (pp. 83–116). Norwood: Ablex.
- De Guerrero, M. C. M. (2004). Early stages of L2 inner speech development: What verbal reports suggest. *International Journal of Applied Linguistics*, *14*, 90–112.
- Diaz, R. M. (1992). Methodological concerns in the study of private speech. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 55–81). London: Erlbaum.
- DiCamilla, F. J., & Antón, M. (2004). Private speech: A study of language for thought in the collaborative interaction of language learners. *International Journal of Applied Linguistics*, *14*, 36–69.
- Dixon, R. A., Fox, D. P., Trevithick, L., & Brundin, R. (1997). Exploring collaborative problem solving in adulthood. *Journal of Adult Development*, *4*, 195–208.
- Duncan, R. M., & Cheyne, J. A. (1999). Incidence and functions of self-reported private speech in young adults: A self-verbalization questionnaire. *Canadian Journal of Behavioural Science*, *31*, 133–136.
- Duncan, R. M., & Cheyne, J. A. (2002). Private speech in young adults: Task difficulty, self-regulation, and psychological prediction. *Cognitive Development*, *16*, 889–906.
- Fernyhough, C., & Fradley, E. (2005). Private speech on an executive task: Relations with task difficulty and task performance. *Cognitive Development*, *20*, 103–120.
- Fraueglass, M. H., & Diaz, R. M. (1985). Self-regulatory functions of children's private speech: A critical analysis of recent challenges to Vygotsky's theory. *Developmental Psychology*, *21*, 357–364.
- Frawley, W., & Lantolf, J. (1985). Second language discourse: A Vygotskian perspective. *Applied Linguistics*, *6*, 19–44.
- Fry, P. S. (1992). Assessment of private and inner speech of older adults in relation to depression. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 267–284). London: Erlbaum.
- Furrow, D. (1984). Social and private speech at two years. *Child Development*, *55*, 355–362.
- Goudena, P. P. (1987). The social nature of private speech of preschoolers during problem solving. *International Journal of Behavioural Development*, *10*, 187–206.
- John-Steiner, V. (1992). Private speech among adults. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 285–296). London: Erlbaum.
- Kimble, K. J., & Margrett, J. A. (2009). Older adults' interactive behaviors during collaboration on everyday problems: Linking process and outcome. *International Journal of Behavioral Development*, *33*, 531–542.
- Kraft, K. C., & Berk, L. E. (1998). Private speech in two preschools: Significance of open-ended activities and make believe play for verbal self regulation. *Early Childhood Research Quarterly*, *13*, 637–638.
- Kronk, I. J. (1994). Private speech in adolescents. *Adolescence*, *29*, 781–794.
- Landis, J., & Koch, G. (1977). The measure of observable agreement for categorical data. *Biometrics*, *33*, 159–174.
- Lantolf, J., & Frawley, W. (1984). Speaking and self-order: A critique of orthodox L2 research. *Studies in Second Language Acquisition*, *6*, 143–159.
- Manning, B. H., White, C. S., & Daugherty, M. (1994). Young children's private speech as a precursor to metacognitive strategy use during task engagement. *Discourse Processes*, *17*, 191–211.
- Matuga, J. M. (2003). Children's private speech during algorithmic and heuristic drawing tasks. *Contemporary Educational Psychology*, *28*, 552–572.
- McCafferty, S. (1992). The use of private speech by adult second language learners: A cross-cultural study. *The Modern Language Journal*, *76*, 179–188.
- McCafferty, S. (1994). The use of private speech by adult ESL learners at different levels of proficiency. In J. Lantolf & G. Appel (Eds.), *Vygotskian approaches to second language research* (pp. 117–134). Norwood: Ablex.
- Meegan, S. P., & Berg, C. A. (2002). Contexts, functions, forms, and processes of collaborative everyday problem solving in older adulthood. *International Journal of Behavioral Development*, *26*, 6–15.
- Quay, L. C., & Blaney, R. L. (1992). Verbal communication, nonverbal communication, and private speech in lower and middle socioeconomic status preschool children. *The Journal of Genetic Psychology*, *153*, 129–138.
- Richardson, J. T. E. (2011). Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review*, *6*, 135–147.
- Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.
- Rogoff, B. (2003). *The cultural nature of human development*. New York: Oxford University Press.
- Sanchez, J. A., & Alarcón, D. (2006). Self-regulation and mastering: Patterns in the development of private speech in illiterate adults. In I. Montero (Ed.), *Current research trends in private speech* (pp. 197–212). Madrid: Universidad Autónoma de Madrid.
- Sanchez, J. A., Alarcón, D., & De la Mata, M. L. (2009). Private speech beyond childhood: Testing the developmental hypothesis. In A. Winsler, C. Fernyhough, & I. Montero (Eds.), *Private speech, executive functioning, and the development of verbal self-regulation* (pp. 188–197). New York: Cambridge University Press.
- Vygotsky, L.S. (1934/1986). *Thought and language*. Cambridge, MA: MIT Press.
- Vygotsky, L.S. (1934/1987). Thinking and speech. In R. Rieber & A. Carton (Eds.), *The collected works of L. S. Vygotsky: Vol. I. Problems of general psychology* (pp. 39–285). New York, NY: Plenum.
- Wertsch, J. V. (1985). *Vygotsky and the social formation of mind*. London: Harvard University Press.
- Wertsch, J. V. (1993). Commentary to Lawrence, J.A. & Valsiner, J.: Conceptual roots of internalization: from transmission to transformation. *Human Development*, *36*, 168–171.
- Winsler, A. (1998). Parent-child interaction and private speech in boys with ADHD. *Applied Developmental Science*, *2*, 17–39.
- Winsler, A. (2009). Still talking to ourselves after all these years: A review of current research on private speech. In A. Winsler, C. Fernyhough, & I. Montero (Eds.), *Private speech, executive functioning, and the development of verbal self-regulation* (pp. 3–41). New York: Cambridge University Press.
- Winsler, A., Carlton, M. P., & Barry, M. J. (2000). Age-related changes in preschool children's systematic use of private speech in a natural setting. *Journal of Child Language*, *27*, 665–687.
- Winsler, A., & Diaz, R. M. (1995). Private speech in the classroom: The effects of activity type, presence of others, classroom

- context, and mixed-age grouping. *International Journal of Behavioral Development*, 18, 463–488.
- Winsler, A., Diaz, R. M., & Montero, I. (1997). The role of private speech in the transition from collaborative to independent task performance in young children. *Early Childhood Research Quarterly*, 12, 59–79.
- Winsler, A., Fernyhough, C., McClaren, E.M., & Way, E. (2005). *Private speech coding manual*. Unpublished manuscript. George Mason University, Fairfax, VA. Retrieved from <http://classweb.gmu.edu/awinsler/PSCodingManual.pdf>.
- Winsler, A., Manfra, L., & Diaz, R. M. (2007). “Should I let them talk?”: Private speech and task performance among preschool children with and without behaviour problems. *Early Childhood Research Quarterly*, 22, 215–231.
- Winsler, A., & Naglieri, J. (2003). Overt and covert verbal problem-solving strategies: Developmental trends in use, awareness, and relations with task performance in children aged 5 to 17. *Child Development*, 74, 659–678.
- Winsler, A., Naglieri, J., & Manfra, L. (2006). Children's search strategies an accompanying verbal and motor strategic behavior: Developmental trends and relations with task performance among children aged 5 to 17. *Cognitive Development*, 21, 218–231.
- Zhou, H., Muellerleile, P., Ingram, D., & Wong, S. P. (2011). Confidence intervals and F tests for intraclass correlation coefficients based on three-way mixed effects models. *Journal of Educational and Behavioral Statistics*, 36, 638–671.