Linguistic Phenomena and Language Selection in the REM Dreams of German-English Bilinguals

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Sixteen German-English bilinguals were studied in a sleep laboratory for four nonconsecutive nights each. Half were native English speakers living in Zürich, and half native German speakers living in Atlanta. Presleep thought samples were solicited each evening and REM dream reports each night; subjects judged the waking appropriateness of their imagined speech and language phenomena, and also identified waking sources of their dream imagery, the following mornings. Incidences of dreaming and of speech therein generally were similar to those of monolinguals. Whether sessions were conducted in German (two nights) or English (two nights) did directly influence language selection in subjects' dreams. Judged appropriateness of language selection to imagined events was very high for thought samples, and high for REM dreams. Sources for thought samples were generally consonant with the language dominant at study site; for REM dreams this relationship was considerably weaker. Judged waking appropriateness to imagined situations was more strongly related to language selection than was the language reference of the supposed sources of those situations.

Seize sujets bilingues allemand-anglais ont été étudiés dans un laboratoire de sommeil pendant quatre nuits non consécutives. La moitié de ces sujets étaient de langue maternelle anglaise et habitait Zurich, alors que l'autre moitié était de langue maternelle allemande et habitait Atlanta. Des échantillons des pensées avant le sommeil, ainsi que des compte-rendus des rêves REM de

chaque nuit, ont été sollicités chaque soir; les sujets devaient juger du carac-
tère approprié à l'éveil des paroles imaginées et du langage utilisé et devaient
également identifier, le matin suivant, les sources de leur imagerie onirique
dans l'état d'éveil. L'incidence des rêves et du langage utilisé étaient générale-
ment identique à celle des unilingues. Le fait d'avoir mené l'expérience en
allemand (2 nuits) ou en anglais (2 nuits) a toutefois influencé directement la
sélection du langage dans les rêves des sujets. Le caractère approprié de la
sélection de langage par rapport aux événements imaginés était très élevé pour
les échantillons de pensées et élevé pour les rêves REM. Les sources des
échantillons de pensée étaient généralement consonnantes avec le langage
dominant au lieu de l'expérience; pour les rêves REM, cette relation était
considérablement plus faible. L'évaluation du caractère approprié à l'éveil des
situations imaginées était plus fortement en relation à la sélection de langage
que ne l'était la référence de langage des supposées sources de ces situations.

INTRODUCTION

Anecdotal accounts often describe dream situations in which characters use
a contextually inappropriate language or in which they speak a language
unknown to their waking life counterpart. But, as has often been observed in
the wake of the discovery of REM (Rapid Eye Movement) sleep, anecdotal
impressions may not give a representative picture of what typically happens
in human dreamlife. The research reported here was designed to determine,
with representatively sampled REM dream reports, typical patterns of
language selection and speech phenomena in the dreams of German-English
bilinguals. We believe that these data have relevance not only to dream
psychology but also in the study of information processing in bilinguals or
multilinguals.

From studies of dominantly monolingual persons, it is clear that speech
plays a central role in dreaming. The major content of human dreams is
social interaction, and the major form of such interaction is speech. From 86
to 100% of "medium" to "long" REM dream reports include speech
(Snyder, 1970). Heynick (1983) has shown, moreover, that dream speech
most often is (contrary to stereotypes attributable to Freud (1900/1955),
among others) both grammatically well-formed and contextually appropri-
ate. In this respect, dream speech is part of a larger pattern of evidence
(reviewed by Foulkes, 1990) against the more general stereotype, fostered
by anecdote, that dreams are poorly integrated phenomena, full of strange
and inappropriate imagery.

To date, the only systematic research on the effect of multiple language
systems on language in REM-monitored dreams has been directed to the
period of second-language acquisition in adults (DeKoninck, Christ, Rin-
fret, & Proulx, 1988; DeKoninck, Christ, Hébert, & Rinfret, 1990). The first
major question we address here is a different one: How does fluent capa-
bility in two or more languages influence the form and substance of REM

dreaming, that is, of the most elaborate form of nocturnal information processing? At the formal level, one can ask whether having speech capability in more than one language facilitates, hinders, or makes no difference in the incidence of speech episodes in dreams. Substantively, one can ask whether the specific content of these episodes and the appropriateness of that content to the dream context in which it is embedded is affected. The implicit comparison here is with the already well-studied speech and other REM-dream phenomena of predominantly monolingual subjects.

Answers to the aforementioned questions may shed light on comparable questions addressed in research on the impact of bilingualism on waking information processing. A major dimension of controversy in this literature has been the degree to which representation/processing systems serving different languages are separate *vs.* shared (e.g. Grosjean, 1982; Hamers & Blanc, 1989; Paivio, 1986). REM dream data are relevant to this controversy because dreaming, like consciousness (e.g. Johnson-Laird, 1983) more generally, reflects the operation of high levels of informational analysis and integration (Foulkes, 1990).

In dreaming, however, there is good reason to believe that mechanisms of informational integration may already be operating under special strain. Specifically, in the absence of patterned input from the world and of voluntary self-regulation that are characteristic of waking experience, mental systems and representations during sleep are subject to more diffuse activation and thus are inherently less susceptible to plausible integration. That representatively sampled REM dream content is, nonetheless, generally realistic and coherent (e.g. Dorus, Dorus, & Rechtschaffen, 1971; Foulkes, 1982; Snyder, 1970; Strauch, 1988), suggests that the integrative systems subserving the organization of conscious experience are not, *per se*, degraded in dreaming. However, *vis à vis* many waking conscious states, in which world and intention act as selective and integrative forces on mental activation, they must be working nearer to their natural limits. Thus, to the degree that the speech representations and processing of bilinguals' two languages are separate rather than interdependent, this should place considerable additional burden on the already strained information integration systems underlying dream consciousness. This, in turn, should be indexed in the form and substance of bilinguals' dream experience, most particularly in speech phenomena in their dreams.

We also address a second major question here, one which we try to answer with data wholly internal to this study. Within the dreamlife of any given bilingual, what determines which language is selected for dream expression in any given dream? Based on our current understanding of the effective degree of information integration achieved in REM dreaming, the most obvious answer would be that that language will be selected which is more appropriate to the rest of the dream context. Thus we had our subjects, in a

Post-sleep Interview, judge the language and speech that they felt to be appropriate to the waking-life occurrence of the events of each of their dreams.

Another possibility, with general implications for modelling the process of dream formation, is that language selection occurs earlier in this process than does the selection of other surface representations in the dream. Based on accounts of dreamlessness accompanying aphasia (reviewed by Foulkes, 1978), it once seemed possible to imagine a central role for language processes in dreaming. However, increased neurophysiological interest in dreaming has suggested both that aphasia can be compatible with dreaming and that lesions to nonlinguistic areas of the brain can be associated with cessation of, or defects in, dreaming (e.g. Murri, Arena, Siciliano, Mazzotta, & Muratorio, 1984; Schanfeld, Pearlman, & Greenberg, 1985; Greenberg & Farah, 1986). Nevertheless, the common narrative potential of dreaming and of language suggests the possibility of linguistic involvement in dream formation at some level higher and more general than simply the implementation of manifest dream speech. Thus language selection may be dictated by the underlying mnemonic sources of the dream, and not just by its superficial context.

A Bolognese group (e.g. Cavallero & Cicogna, 1984; Cicogna, Cavallero, & Bosinelli, 1986; Cavallero, Cicogna, & Bosinelli, 1986) has recently developed techniques through which research subjects identify mnemonic sources of their own manifest dream imagery. This makes it at least theoretically possible to discriminate dream sources from the dream events they occasion, and in the case of dream speech, to discriminate the predominant language associated with dream sources from the predominant language of dream speech. Although not "deep" in a psychodynamic sense, dream sources are presumed to reflect the mnemonic units active early in the process of dream formation rather than those enlisted later in the formation of the particular surface representations of the dream itself. Thus we also had our subjects, in the same Post-sleep Interview, identify dream sources following the Bolognese techniques.

Still other possibilities include that there may be a general bias, other factors equal, toward the self-described first language (L1) as vs. the usually later-acquired and self-described second language (L2), or that, when (as in our study), persons are currently living and studying/working in an L2 environment, there may be a bias toward the concurrently used L2. Or it might be that it is the immediate presleep environment of the dreamer that is a critical determinant of language selection in dreams. To test this possibility, we systematically varied the language spoken in the laboratory the evening before and during prior dream interviews within a night itself.

METHOD

Subjects.   Eight native English-speaking persons, living and working or studying in the Zürich area (hereafter "Zürich subjects"), and eight native German-speaking persons, living and working or studying in the Atlanta area (hereafter "Atlanta subjects"), were recruited through personal contacts. In each setting, there were seven female subjects and one male subject (mdn age in Zürich = 28.5, range 19–57; mdn age in Atlanta = 31.5, range 23–52). Subjects were paid for their services.

Before initiation of data collection at either site, subjects were given an "Information for Volunteers" pamphlet, describing the nature and goals of the project, were shown the laboratory facilities and equipment to be used in taking sleep recordings, and completed brief questionnaires regarding everyday dream recall, demographic data, and language history. If they agreed to participate (as all did) after the laboratory tour, subjects also signed consent forms.

The information pamphlet characterized the goal of the project as description of the nature and determinants of language usage in bilinguals' dreams. Among such potential determinants, they were told, are: the context of dream events (thus they would be asked, in morning interviews, to imagine the dream events to have happened in wakefulness and to say which language and speech content would be appropriate in that waking context), the mnemonic sources of the manifest dream imagery (thus, in the same interviews, they would be asked to identify dream sources and their associated language), and the immediate context in which dreams are collected (thus, they were told, some laboratory sessions would be conducted entirely in German and some entirely in English). Copies of the standardized nocturnal dream-solicitation interview format and of the standardized postsleep interview format were appended to the pamphlet, and were further discussed with subjects.

In completing their "Language Biography", subjects described, for each language in which they claimed oral competence, initial age of acquisition, context of acquisition, usage by age and context, and, on a 1 ("practically none") to 7 ("native-like") scale, their self-evaluated proficiency in each language. All subjects rated L2 proficiency either 6 or 7. Since orientation procedures were conducted via L2, experimenters had additional independent evidence of subjects' L2 competence before initiation of primary data collection.

Procedure.   Subjects spent four non-consecutive nights in the sleep laboratory, two on which only German was spoken, and two on which only English was spoken. The first four authors comprised the interview team, with each of us responsible for interviewing four of the subjects at each site in our native language. There were four language orders (L2 L2 L1 L1; L1

L1 L2 L2; L1 L2 L1 L2; L2 L1 L2 L1), with two different interviewer pairs assigned to each order at each site. The pattern from Zürich, where nights were run first, was later duplicated in Atlanta (with the same interviewer-pair and language order assigned to the lone male subject at each site).

On arrival at the laboratory, subjects changed into their bedclothing and then had a total of eight small metal-disk electrodes attached with tape: four to their foreheads (for EEG recording); one lateral to each eye (for EOG recording); and one at each mastoid process (as neutral reference). Following connection of all electrode wires to a terminal box at the head of the bed, but preceding lights out, subjects participated in three thought-sampling interviews, at standardized times (3, 7, and 5 minutes, respectively) since their last conversation with the experimenter. Using the same standardized interview and subject-alerting procedure as in later nocturnal interviews, the experimenter asked the subject to describe "What was going through your mind just before I called you?" Following solicitation of a spontaneous report, subjects then were asked "During this experience itself, did you or any character ever speak?" If so, they were asked to describe the occasions, identifying who spoke to whom, what was said and in what language, and to say whether they actually seemed to hear the speech or simply knew that it happened without actually hearing it. Finally subjects were then asked if, during the experience, they seemed "to be engaging in thinking in words, without ever actually saying anything out loud?" If so, they were asked to describe the occasions and identify the language involved. Prior to the thought-sampling procedure, which is modelled on that of Foulkes and Fleisher (1975), subjects had been informed that although not all of these dream-interview questions might always be appropriate to their waking thoughts, for comparative purposes we wanted to use the same procedure to establish a waking baseline for our dream observations. Physiological recordings were taken during the thought-sampling, to ensure that subjects maintained wakefulness (if not, they were alerted, and the trial-clock reset).

Following the last thought-sampling interview, conducted while subjects' bedrooms were still moderately illuminated, lights were turned out as the sleep period began. Our original plan had two orders of awakenings scheduled for the night's first four REM periods, based on the number of minutes since REM onset (5-8-5-8 and 5-8-12-12). However, skipped REM periods as well as delays due to inability to determine if REMs would return after major body movements compromised our ability to examine time since REM onset as a systematic variable. Otherwise the overall plan remained intact: awaken subjects during the first four REM periods (or three, if the first REM period was delayed beyond 150 minutes of sleep following sleep onset) if they are at least 5 minutes long (and, generally, longer than that).

Nocturnal awakenings were initiated, whether or not there was immediately concurrent REM activity, on the basis of elapsed clock time since REM

onset (with qualifications as mentioned earlier). As also was true in the presleep thought-sampling situation, the subject was alerted by a voice over an intercom, the subsequent interview was conducted via the intercom, and the interview was tape-recorded for later transcription. EEG/EOG recordings were taken throughout the night until completion of the awakening schedule.

Following their final morning awakening, subjects had their electrodes removed, and they washed up and dressed for the day. Before leaving the laboratory, they participated in the Post-sleep Interview. Here they heard, in order, the recording of each thought-sampling interview that was associated with a dramatized imagining of a situation and of each nocturnal interview for that session. Following each playback they were questioned as follows: "If what you just described imagining had really happened, do you think there would have been any speech accompanying it?" If so, they were asked to describe such speech, and then to indicate on a 5-point scale (definitely L1; probably L1; could be either L1 or L2; probably L2; definitely L2) the language appropriate to the waking occurrence of the imagined events. Where the dream had been experienced with speech whose content they had remembered, they further were asked to describe the match of dream speech content with that of waking-appropriate speech content on another 5-point scale (1 = practically identical; 2 = pretty much the same; 3 = similar in some ways but different in others; 4 = pretty much different; 5 = almost totally different). Where subjects (very rarely) did not judge speech to be waking appropriate to imagined events, but had in fact experienced speech in their waking or dreaming imaginings, they were asked to identify the language more appropriate to the imagined situation.

Manifest dream sources also were solicited following each playback of a subject's interview, following procedures described by Cavallero, Foulkes, Hollifield, and Terry (1990). Specifically, subjects were asked to identify "immediate sources" for successive thematic units from their dreams either in their general waking knowledge or in specific waking memories. Subjects then were asked to judge whether the context of the report's sources in the dreamer's waking life was more L1 or L2 related (subjects were permitted, but not encouraged, to say "either", "neither", or "both").

Where subjects indicated that different segments or sections of a dream had different waking language-appropriateness and/or sources of different linguistic association, they were permitted to answer the Post-sleep Interview separately for each such segment or section. The Post-sleep Interview often was conducted with interviewers and subjects each following their own copy of the schedule. Subjects were encouraged to take notes (pencil and pad provided) on playbacks of relatively extensive reports, to aid in their response to subsequent questions about those reports.

Thus, as generally was pointed out to subjects both in orientation and at the start of each laboratory session, the evening (thought-sampling) and nocturnal (dream) interviews differed from the Post-sleep Interview in that they involved merely *reporting* mentation one already had experienced. In the Post-sleep Interview, on the other hand, subjects' special knowledge was solicited in *evaluating* these mentation reports, specifically in evaluating what language and speech content, if any, would be waking-appropriate to the imagined events of those reports and in evaluating the more obvious sources of the dream imagery in the dreamer's own life history or general knowledge, and their linguistic context.

Although both sets of standardized interview protocols have been described here in English, they were, of course, performed in German on German-language nights at each site.

RESULTS

Results will be described statistically in terms of median-subject values (mostly percentages) in different conditions (evening thought sample *vs.* nocturnal dream; Zürich subjects *vs.* Atlanta subjects; German interviews *vs.* English interviews). With subjects as the units of analysis, intrasubject comparisons were made with the Wilcoxon Matched-pairs, Signed-ranks test, while intersubject comparisons used the Mann-Whitney U test (with $P < 0.05$, 2 tail significance levels throughout).

Recall. The typical subject had recall on all thought-sampling occasions, whether studied in Zürich or in Atlanta, and whether interviews were conducted in English or in German. English-language interviews were slightly but not significantly more likely to elicit REM dream reports in both settings (100% *vs.* 88% in Zürich, 94% *vs.* 87% in Atlanta). Presleep-recall figures are consistent with those of other research (Foulkes & Fleisher, 1975; Foulkes & Scott, 1973). Dream-recall figures are toward the high-end of typical laboratory findings, indicating that bilingualism in no way necessarily impedes REM dreaming or dream recall.

Linguistic Phenomena. Table 1 describes the percentage of content-producing arousals that contained linguistic representations: Either overtly realized speech by imagined characters or "thinking in words". There were unanticipated Zürich *vs.* Atlanta differences in the incidence of *overt language*. That variable was represented about equally often in Zürich thought samples and REM reports, while Atlanta subjects reported significantly more speech, self-speech, and self-and-other speech on REM awakenings than they did in presleep thought samples (and, on English-language nights, than did Zürich subjects on REM awakenings). The effect was that, compared to normative data, Zürich subjects were unexpectedly high in (generally hallucinated) overt speech in thought samples (*cf.* Foulkes &

TABLE 1
Effect of Site of Study and Language of Interview (E = English; G = German) on Median-S
Percentage of Content-producing Arousals with Various Forms of Linguistic Representation

| | Thought samples | | | | REM reports | | | |
| | Zürich | | Atlanta | | Zürich | | Atlanta | |
	E	G	E	G	E	G	E	G
Overt speech**	58	58	25 •	33	57ᵃ	62	84ᵃ *	84
self**	25	34	0 *	25	38	43	54 •	62
other	17	17	8	0	16	18	33	23
both	17	25	0 *	8	22	43	44 *	43
Thinking**	67	83	50ᵃ	67ᵃ	29	38	25	42
Think or Speak	100	92	58ᵃ	92ᵃ	66ᵇ	76	86ᵇ	93
Speech heard	75	55	100	75	50	62	78	64

Entries in the same *row* with common superscripts are significantly different
*Significant difference at this site between REM reports and thought samples for this variable
**Significant difference over both sites between REM reports and thought samples for this variable

Fleisher, 1975; Foulkes & Scott, 1973) and unexpectedly low in overt speech and self-initiated speech in REM dreams. Thus, only the Atlanta REM-dream figures in Table 1 are closely comparable to findings with monolingual Americans of 83% (Foulkes, 1960) to 86% (Snyder, 1970) average incidence of dream speech and 60% average incidence of self-initiated speech (Foulkes, 1960). At least for the Atlanta subjects, one could conclude, then, that dream speech is not reduced as a result of bilingualism.

Over all 16 subjects, any instance of *self speech* was more likely than speech only by others. Significant self *vs.* other character differences were found for German and English sessions, both in thought samples and in REM reports. Self speech was significantly more frequent in REM reports than in thought samples, a partial reflection of the more general speech difference between the two report classes.

Not surprisingly, *verbal thinking* was more characteristic of the waking thought samples while hallucinated speech was more characteristic of REM dreams. Over all 16 subjects: thinking was present significantly more often than overt speech in waking thought samples; overt speech was present significantly more often than thinking in REM dreams; thinking was present significantly more often in thought samples than in REM reports; and overt speech was present significantly more often in REM reports than in thought samples.

Thinking or speaking—the presence of *linguistic representation* at either a covert or overt level—was reported significantly more often by Atlanta subjects than by Zürich subjects in English-session REM reports. German language interviews, on the other hand, produced both significantly more

cations, is yes. Looking at the bottom two rows of the Table, it appears that good predictions back to language of session could not be made from language of actual *linguistic representation* (speech or thinking) for Zürich subjects or for German-language interviews. However on Atlanta English-language sessions, English representations were significantly more frequent than German ones both in presleep thought samples and in REM reports.

Better predictions were found from language of session forward to language of actual linguistic representation. Attributable mainly to Atlanta subjects, German sessions yielded significantly more German linguistic representation (and thinking in German) in thought samples than did English sessions. At both sites, German-language sessions were associated with significantly more REM-dream representations in German that were English-language sessions, and, in Atlanta, English-language sessions were associated with significantly more English dream representations than were German-language sessions.

Prediction from language of session was even more successful when the prediction was of that particular form of speech representation most characteristic of a state: Thinking in thought samples and overt speech in REM dreams. For *thought samples*, there was significantly more *thinking* in English on English than on German sessions and significantly more thinking in German on German than on English sessions. These effects were heavily dependent on Atlanta subjects (for whom they were significant), rather than Zürich subjects (for whom they were not). For *REM reports*, on the other hand, *overt speech* was affected by language of session: specifically, on German-language nights there was a significantly greater frequency of REM reports in which both self and others spoke German than on English-language nights, and on English-language nights, other characters spoke English significantly more often than German. On English language nights other characters also spoke English significantly more often than did the self; a comparable trend to more other- than self-speaking German on German-language nights was marginally significant ($P = 0.063$).

In thought-sample *vs.* dream comparisons, whether sessions were conducted in English (where the overall effect was mostly attributable to Zürich subjects) or in German, there was significantly more German *linguistic representation* in thought samples than in dream reports. English representation did not show a comparably significant fall-off from thought sample to REM dream. Atlanta subjects had *thinking* significantly more often in English than in German in English-language presleep thought-samples but dreamed of thinking more often in German than in English in German-language REM reports.

The *absolute incidence* (over all content-reports) *of thinking* by language revealed that native English speakers, regardless of language of session, thought significantly more often in German (but not in English) awake

(thought samples) than asleep (REM reports), and that native German speakers, regardless of language of session, thought significantly more often in English (but not German, except on German language sessions) awake than asleep. These findings are consistent with the hypothesis that thinking in a second language is a relatively more difficult cognitive achievement than thinking in a first language, and that difficult cognitive achievements are more readily realized in wakefulness than during REM sleep.

In similar analyses, over all content-reports, Atlanta subjects had significantly higher absolute frequencies of thinking in German, both awake and asleep, on German-language than on English-language sessions. The same findings were observed for all 16 subjects considered together, but not for the native English speaking Zürich subjects.

Dreaming/Waking Relationships. First, we examined subjects' morning ratings of which language would be appropriate to the waking occurrence of the events of a dream or a dramatized thought sample. Subjects could make these ratings more than once per arousal (in cases in which they perceived that the rating might be different for different parts of an arousal's mentation). Subjects also could choose the alternative that either/neither language might be appropriate to the waking occurrence of imagined events, but such ratings are excluded from the data analysis described in the following table.

Table 3 presents an analysis of waking language-appropriateness ratings in relation to the language of the speech subjects actually reported in their

TABLE 3
Median-S Percentage of Congruence of Waking-appropriate and Mentation-experienced Language, by Site and Language of Interview (E = English; G = German)

| | *Thought samples* | | | | *REM reports* | | | |
| | *Zürich* | | *Atlanta* | | *Zürich* | | *Atlanta* | |
	E	G	E	G	E	G	E	G
Wholly Congruent								
Definitely**	100	100	100	100	84	88[a]	100[b]	50[ab]
Definitely or								
Probably***,**	100	100	100	100	100	71	94[a]	55[a]
Partially Congruent								
Definitely**	100	100	100	100	100	100[a]	100	84[a]
Definitely or								
Probably**	100	100	100	100	100	89	* 100	80

Entries in the same *row* with common superscripts are significantly different
*Significant difference between English and German nights for this mentational class
**Significant difference over both sites between German-language REM reports and German-language thought samples
***Significant difference over both sites between all REM reports and all thought samples for this variable

mentation. In this analysis, dream-waking relations were considered *wholly* congruent where the waking-relevant rating specified one language and that same language and only that language was described in a subject's mentation report (or in a particular section of such a report); relations were *partially* congruent where the waking rating specified one language and that language, along with some other language, was described in a subject's mentation. Congruences (wholly, partially) could be definite or probable, depending on the subject's morning judgement of the degree of waking appropriateness of a language to the imagined events of mentation reports.

From the data of Table 3, it appears that language selection in waking imagination is very nearly infallible, while that in dreams is less so. For example, on both German and English interview nights, definite/probably wholly-congruent relationships were scored significantly more often in thought-samples than in REM reports. But the data also indicate that dreaming's reputation for extensive contextual bizarreness is, in general, not justified, given the generally high degree of waking-dreaming congruence in language selection. Most interesting is the finding that native German speakers, studied in an English-speaking larger environment, but interviewed in German, had least success in matching language appropriately to REM dream scenarios. Thus: in Atlanta, English nights were significantly higher than German nights in both wholly-congruent categories; Zürich subjects were significantly higher than Atlanta subjects in both definite categories on German nights; English nights were significantly higher, across all 16 subjects, than German nights in definite/probable partial congruence; and German-language evening reports were significantly more congruent in all four tabled categories than were German-language night reports.

Overall, ratings that English was appropriate to imagined REM-dream events were significantly more likely to be made for English-language sessions than for German-language sessions (an effect mainly attributable to Atlanta subjects) while ratings that German was appropriate to such events were significantly more likely to be made for German-language sessions than for English-language sessions (an effect mainly attributable to Zürich subjects). No such overall effects were found for evening thought samples, suggesting a paradoxically greater penetration of the immediate presleep environment into later dream mentation than into presleep mentation itself. Effects of the larger linguistic environment (i.e. significant Atlanta-Zürich differences) were found for the waking thought samples: in either language-of-session, English was judged appropriate significantly more often in Atlanta than Zürich, while German was judged appropriate significantly more often in Zürich than Atlanta (but only on English-language sessions).

Next, we examined subjects' ratings of the waking appropriateness of the specific content of imagined mentational speech, regardless of the language

TABLE 4

Median-S Ratings (1 = "practically identical") of the Waking-appropriateness of the Substance of Imaginal Speech by Site and Language of Interview
(E = English; G = German)

| | Thought samples | | | | REM reports | | | |
| | Zürich | | Atlanta | | Zürich | | Atlanta | |
	E	G	E	G	E	G	E	G
% of 1's	60	78	89	67	0	0	15	29
% of 1's/2's	100	100	100	100	50	25	79	50
x*		1.40	1.23	1.11	1.40	2.59	3.00	2.22	2.32

*Significant difference over both sites between REM reports and thought samples for this variable

of that speech. Subjects' comparisons of the content of imagined mentational speech and that which would be waking-appropriate to imagined mentational events was in terms of the following scale points: 1. practically identical; 2. pretty much the same; 3. similar in some ways but different in others; 4. pretty much different; 5. almost totally different. Table 4 presents the median-subject mean content ratings and proportion of "1" ratings and "1" or "2" ratings in the same conditions as in prior tables.

Once again, there are clear thought-sample vs. REM-report differences. For instance, average ratings were significantly higher (speech content was judged less appropriate) for REM-reports than for thought-samples in both English and German sessions at both sites. Atlanta (native German-speaking) subjects had generally higher REM speech appropriateness than did Zürich (native English-speaking) subjects, but this difference was not significant. Finally, over both sites, there also were significant effects specific to German-language sessions: for example, the percentage of ones (highly appropriate speech content) was significantly greater for German than English speech in thought samples, but for English than German speech in REM dreams.

Dream Sources. After their identification of putative dream sources, subjects characterized these sources as German-related, English-related, or both/neither. The median-subject distribution of these alternatives is given in the first 3 rows of Table 5. For *thought samples*, there was a clear trend to sources linguistically consonant with site (especially for English in Atlanta, but also for German in Zürich). English sources were significantly more prevalent in both German and English interview sessions in Atlanta than in Zürich, while German sources were significantly more prevalent in both German and English interview sessions in Zürich than in Atlanta. For *REM reports*, on the other hand, there were, at best, only marginally significant (P <0.10, 2-tail) trends toward sources linguistically consonant with site (more English sources in Atlanta than in Zürich with interviews of both

TABLE 5
Median-S Attribution of Linguistic Context to Dream Sources, and Congruence of
Source Language and Mentational Language, by Site and Language of Interview (E =
English; G = German)

| | Thought samples | | | | REM reports | | | |
| | Zürich | | Atlanta | | Zürich | | Atlanta | |
	E	G	E	G	E	G	E	G
Sources (%)								
English	21	17 •	90	74	39	18	64	40
German	54	33 •	0[a]	8	31	40	20[a]	0
Both	0	50	0	22	31	31	0	50
Single-language source								
Wholly Congruent	60	29	34	50	33[a]	33	71[a]	45
Partially Congruent	60	42	34[a]	50	50[b]	50	82[ab]	60

Entries in the same *row* with common superscripts are significantly different
*Significant difference over both interview languages between Zürich and Atlanta for this
mentational class

languages; more German sources in Zürich than in Atlanta but only with
German interviews). Also marginal in significance were findings that
English sources were more likely for evening than for REM reports in
Atlanta on interview sessions in each language. German sources, on the
other hand, were found significantly more often for REM reports than for
thought samples in English interview sessions in Atlanta.

Were mentational sources and their linguistic contexts related to the
language of imagined speech events? Were such sources stronger, or
weaker, determinants than waking appropriateness ratings of the languages
spoken in imagined situations? Comparison of the fourth and fifth rows of
Table 5 with entries in Table 3 indicates that waking appropriateness to a
momentarily imagined situation is a considerably stronger determinant of
language selection in both waking and dreaming mentation than is the
mnemonic source of that situation and its linguistic context. This result is
especially clear for waking thought samples, but also holds for REM-dream
reports. (Too few subjects identified both-language sources of imagined
mentation for meaningful statistical analysis of language selection in such
cases.)

Unlike situational-appropriateness, whose determination of language
selection was more powerful and pervasive in thought samples, the stron-
ger prediction from source to language selection was for REM dreams,
specifically for dreams of Atlanta subjects interviewed in English. On
English interview nights, Atlanta subjects showed significantly more whole
or partial congruence (i.e. the language identified as source was the only
language present or was among languages present in mentation) than did

Zürich subjects. They also had significantly more partial congruence in English REM-reports than in English thought-samples.

Over all subjects, but for English-language nights only, source was reliably associated with the language of dream speech: on these nights there were significantly more instances of the self speaking English on English- than on German-source occasions and of the self speaking German on German- than on English-source occasions; other characters also spoke English significantly more often on English-source than on German-source occasions. There were too few relevant cases to permit meaningful analysis of the language of subjects' dream thinking.

Tonic vs. Phasic Awakenings.   As noted earlier, REM awakenings in this study were made on the basis of elapsed clock time since REM onset, rather than presence of concurrent eye movements. This made it possible, as in earlier research with children (Foulkes & Bradley, 1989), to compare phasic (REM burst within 15 seconds of awakening) and tonic (no REM activity within 15 seconds of awakening) REM reports. The comparison is theoretically significant, since neurobiological theory (Hobson & McCarley, 1977) predicts that dream bizarreness is enhanced by intrusive phasic activation. Our data on ratings of the waking appropriateness of the specific content of imagined mentational speech do not support this hypothesis: in fact, overall ratings (where: 1 = most appropriate and 5 = least) showed more speech-content appropriateness on phasic (2.33) than on tonic (2.58) awakenings (the difference was significant in Zürich, but not in Atlanta or overall). Where self-speech is viewed as one of the serial-integrative mechanisms of dream construction (a means largely ignored by neurobiological theory, with its focus on momentary visual imagery: Heynick, 1983), it is interesting that its incidence was significantly higher on phasic than on tonic awakenings.

DISCUSSION

Linguistic Phenomena.   As noted, there were several respects in which the native English-speaking subjects who were studied in Zürich deviated from norms set by monolingual English-speaking subjects. Since native German-speaking subjects studied in Atlanta conformed to norms of monolingual English-speaking subjects, these differences cannot be due to bilingualism *per se*, and we have no evidence that these differences are due to the L1 = English/L2 = German combination in Zürich. The simplest explanation, based on observations made during the study, is that Atlanta subjects (who generally were professionally oriented and understood the need for scrupulous description of mental experience) were less prone to confabulation than Zürich subjects (some of whom seemed, despite our orientation efforts, quite unfamiliar with the research process and their assigned roles

therein). Specifically, the Zürich subjects were more likely to generate stereotyped reports (preservation of the same theme) that probably were genuinely responsive neither to mentation nor to psychophysiological state, and Zürich subjects were more likely in the morning not to recognize reports that they had made during the night.

We do not believe that this happened sufficiently often to compromise all of our research goals nor to alter patterns in the data of specific interest to us, but it may help to explain unanticipated Atlanta *vs*. Zürich differences in whether such patterns attained statistical significance. For example: only in Atlanta did dreams have more overt speech than thought samples; only in Atlanta was overt speech consistently more prevalent than thinking in REM dreams. We could not find psychophysiological data (e.g. state at thought-sample arousals, sleep latency following thought-sampling) to support the alternative hypothesis that Zürich subjects were generally sleepier than Atlanta subjects during thought sampling, and even were that hypothesis true, it could not explain the discrepancies in the Zürich dream data.

Language Employed.   Language of session influenced language of linguistic representation, particularly in Atlanta, and particularly when form of representation (thinking *vs*. overt speech) was modal for a report class (thought sample *vs*. REM dream). It also was observed, at both sites, that the largest absolute differences in language of mentation were on evening and night sessions in which language of the sociocultural context (German in Zürich, English in Atlanta) was identical with (reinforced by) language of session.

The generally meagre effect ascribed to presleep variables *vis à vis* dream content rests mostly on attempts to influence the specific content of a dream (i.e. the memories and knowledge that provide the raw material of the dream). But our results indicate that generalized processing systems involved in dream construction can, without too much effort, be primed/de-activated by presleep manipulations. In this respect, our results are similar to those of Roffwarg, Herman, Bowe-Anders, and Tauber (1978), who showed that "red" dream imagery could be increased, in a transitory way, by presleep viewing through red goggles (*cf*. Foulkes, 1985, p. 178).

Thought-sample *vs*. REM dream comparisons are interesting, in that the two conditions presumably reflect different levels of stress on language processing systems: the more diffuse mnemonic activation of stage REM is exacerbated by an accompanying absence of voluntary self-regulation, making thought generation more problematic than in relaxed wakefulness. In this respect, it is not surprising that the absolute incidence of thinking in either second-language was significantly lower in REM reports than in waking thought samples. But, in this same regard, it is interesting to note that the overall representation of German-language (but not English-language) mentation was significantly higher in waking thought samples than in REM reports, as if it were more difficult, no what matter what one's

L1 might be, to use German (*cf.* also the finding that English speech content was more "highly appropriate" than German speech content in REM dreams on German nights).

Another gradation of difficulty in effecting speech representation in dreams may be other *vs.* self overt speech (on both English and German sessions, other characters spoke the language of session more often than did the self). We know, from ontogenetic data (Foulkes, 1982; Foulkes, Hollifield, Sullivan, Bradley, & Terry, 1990) that active self participation is a relatively late dream achievement, as *vs.* participation of other dream characters, and the present data suggest more processing constraints on primed self-speech than on primed other-speech in adult bilinguals. Thus, against the general trend to more self-initiated than other-initiated speech, when a particular language system has been primed in the presleep period, it is *not* the self who most often will use that language in later dreams.

Dreaming/Waking Relationships.   Results here are relatively easily summarized: (1) The language of speech in waking thought samples was strongly related to the language judged life-appropriate to imagined events; (2) language selection in REM dreaming also was highly constrained by situational or contextual appropriateness, although significantly less so than in waking thought samples (and least so in German-language sessions in Atlanta); (3) each language was judged more appropriate to imagined REM events on nights when it was language-of-session than when it was not; (4) language of session did *not*, on the other hand, reliably predict the language appropriate to thought-sample contents; (5) there was, however, evidence for influence by larger sociocultural context (site of study) on thought samples (e.g. English was judged more contextually appropriate for Atlanta thought-sample events, regardless of language of session); and (6) when the life-appropriateness of the specific content of imagined speech (in whatever language) was examined, it was again significantly higher for thought samples than for REM reports.

Dream Sources.   For thought samples, identified sources of imagined events were influenced more by larger sociocultural context (language of community) than by presleep context (language of session). REM sources, on the other hand, were somewhat less predictable from either context, and, in Atlanta, somewhat less likely to reflect sociocultural context than were thought-sample sources. In this relative sense, then, REM dreams were more "isolated" from immediate life sources than were waking thought samples (Rechtschaffen, 1978), although, as noted earlier, they were by no means impervious to situational determination.

Both in thought samples and in REM dreams, language selection was better predicted by contextual relevance within an imagined scenario than by mnemonic source of that scenario. This suggests that selection of L1 *vs.* L2

is made relatively late in dream and daydream (only dramatized thought-sample reports were evaluated for source) construction, after the parameters of the momentary imagery are specified, rather than relatively early, at a point when the personally meaningful memories that will help to give an episode its thematic content first have been activated. Although not as relatively well as immediate contextual relevance, source was significantly related (on English-language sessions only) to the language of REM dream speech.

Overall, the results suggest the following differences between daydream and REM-dream generation: (1) Whereas immediate contextual relevance is a relatively better predictor of language selection in daydreams than in REM reports, identified sources are a relatively better predictor of language selection in REM reports than in daydreams. This suggests a deeper or more diffuse origin of REM reports, with less "obvious" or "immediate" determination of the language of dream speech; (2) looking at the identified sources of mentation reports, daydreams were more likely than REM dreams to have sources coded in the language of the larger sociocultural context (i.e. to draw on presumed events of the dream day and earlier days), while REM dreams were more likely to contain situations to which language-of-session was appropriate than were thought samples. This suggests more specific-content mediated influence of relatively recent events on daydreams, but more effect of recent and relatively short-lived process-priming (L1 or L2) on REM mentation.

CONCLUSION

In terms of the larger objectives of this study, we reach the following conclusions: (1) subject to our performance-level interpretation of Zürich data, bilingualism in no way impedes dreaming itself nor the appearance of well-formed, contextually appropriate language phenomena within dreams, which suggests that high-level processing systems serving different languages are largely shared, rather than separate; (2) language selection appears to occur, therefore, relatively late in the dream construction process, on the basis of contextual relevance to an immediate imagined situation; (3) language selection conforms to the more general rule of effective information integration in REM dreaming; (4) it is possible to influence language selection in dreaming by presleep priming of a specific language; (5) in a design in which fundamental psychological processes are studied in bilinguals at different sites and in different immediate linguistic contexts, there will be a predictable pattern in which some findings apply generally to persons competent in both languages (regardless of which is L1 and which L2), while others are dependent on site (sociocultural linguistic context,

unintended differences in subject selection) or immediate linguistic context (including language of data collection).

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