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Recommended Citation

Donna Jo Napoli and Stephanie Liapis. (2019). "Effort Reduction In Articulation In Sign Languages And Dance". *Journal Of Cultural Cognitive Science*. Volume 3, Issue 1. 31-61. DOI: 10.1007/s41809-019-00027-3

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Effort reduction in articulation in sign languages and dance

Donna Jo Napoli · Stephanie Liapis

Received: 5 March 2019 / Revised: 18 July 2019 / Accepted: 22 July 2019 / Published online: 25 July 2019
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Abstract Sign languages exhibit the drive for ease of articulation found in spoken languages, particularly in fast and casual conversation, where the methods that reduce effort are shown here to be limited by the need to maintain recognizability. Participatory dance, which uses the same articulators as sign languages plus additional ones, also demonstrates methods of reducing biomechanical effort, analogous to those seen in sign languages, and, again, limited by the need to maintain recognizability of the dance figures/phrases. However, when we look at performance language (here, sign poetry) and performance dance, we find a contrast: sign language poetry uses reduced and enhanced forms, while performance dance does not use reduced forms but often uses enhanced forms. We attribute this contrast to the different functions of the different types of language and dance, with attention to the notion of intention in performance dance.

Keywords Dance · Sign languages · Biomechanical effort · Recognizability · Articulation

Introduction

In this paper we compare sign languages and dance with respect to expenditure of biomechanical effort in articulation. We argue that both exhibit methods of reducing effort and, thus, easing articulation and that those methods are analogous and constrained by the need to maintain what we call recognizability. Artistic articulation, as in sign language poetry and performance dance, differs from conversational language and participatory dance, in that enhancement occurs often, which calls for extra effort. Further, while sign language poetry can exhibit methods for effort reduction, those methods might very well not be visually apparent in performance dance at all.

Why compare language and dance: our hypotheses

The principle of least effort (PLE) was proposed by Zipf (1949) to apply to all individual and collective human behavior: essentially, the PLE claims people tend to expend the least effort in their activities. While Zipf does not refer to earlier works for this idea, more than 50 years earlier Ferrero (1894) proposed the same principle regarding human mental activities. The PLE has been useful in explaining a variety of ordinary behaviors of humans, most recently how people use electronic resources (Case 2005). The PLE is not a universal truth, nor was it proposed to be; many types

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of incentive can lead people to perform a task in a more energy-expensive way even when a less energy-expensive alternative exists, from wanting to impress others, to personal satisfaction from knowing they did their best, to obeying an instruction to work hard and concentrate, to wanting to be cooperative, and so on (both Zipf and Ferrero acknowledge this).

Effort can be of many types (physiological, computational, emotional, etc.), but our focus here is on biomechanical effort. Looking at goal-directed movements, the job of trying to understand why one implements a particular way to perform a task is complex, given multiple possible motor-control strategies and the abundance of degrees of freedom (considering the multiple articulators involved in many tasks). It appears, though, that the PLE might well be extended to account for kinematic behavior in humans and animals. Shortcutting a movement—that is, not articulating the movement in the ‘ideal’ way, but, instead, in some way that is somehow ‘lesser’ (as compared to a baseline) is a frequently used and visually obvious method for reducing biomechanical effort. Less visually obvious methods include finding a way to do the movement fully (i.e., matching that baseline), but simply with less energy expenditure; that is, being more efficient.

Shortcutting methods are common as someone grows tired or as someone needs to adjust energy output to meet other demands (often demands for increasing speed). However, they are not limited to these situations. For example, children change from using proximal to distal articulators as they gain motor control and can articulate faster (Gesell 1929; Gesell et al. 1934; Kuypers 1981; Jensen et al. 1995; Saida and Miyashita 1979; and others); this is a visually-obvious method of effort reduction, but it is due to learning ways to be efficient and it comes with growing expertise (not with exhaustion, nor necessarily with demands for increasing speed).

Efficiency methods are common as experience and expertise in doing a movement increase. For example, the kinematic paths of humans in reaching (Nakano et al. 1999) and walking (Anderson and Pandy 2001) have been argued to minimize the energy costs of movement. Likewise, waddling in penguins appears to do this (Griffin and Kram 2000), and the transition from walk to trot in horses appears to occur at the speed that is most economic metabolically (Griffin et al. 2004). Further, it is not just ordinary physical

activity that shows this tendency: elite human runners position their heels in such a way as to lower metabolic energy consumption (Scholz et al. 2008). In general, as movement sequences become longer and more complex, modifications and adaptations are made to lead toward efficiency; movement sequences are performed with less energy, often even as they become more spatially and temporally accurate (Donchin, Francis, and Shadmehr 2003; Milton et al. 2004; Wulf et al. 2010; Ranganathan et al. 2013). Efficiency methods to reduce energy consumption include the advantageous use of momentum and the use of interactive muscle forces and energy transfer to modulate acceleration and deceleration (Dickinson et al. 2000). In general, then, efficiency methods are the result of expertise.

It appears that physical activities generally demonstrate a drive for biomechanical ease of articulation (whether visually obvious or not), but, again, the drive to reduce effort is not always exhibited. For humans and animals, both reward and effort influence motor control, in that if they have a choice between two stimuli, they move toward the more rewarding one (the one that requires less effort to reach) but at a faster speed, regardless of whether we consider walking, flying, or reaching (Sackaloo et al. 2015; Shadmehr et al. 2016).

When we turn to language, the PLE might well be taken as the underlying force that accounts for the well-established drive for ease of articulation in both spoken and sign languages (Shariatmadari 2006; Napoli et al. 2014 and the references within): that is, languages naturally employ methods of reducing effort in production. This drive is particularly apparent in casual, quick conversation and in the way languages change over time (Kirchner 1998, 2004). Keller (1990/1994) proposes that language users follow a set of maxims, one of which is: ‘Talk in such a way that you do not expend superfluous energy’ (p. 98). Once more, not just matters of acoustic and articulatory energy enter into language use, variation, and change; language users’ attitudes and intentions can lead them to deliberately choose to use more energy-expensive articulation (Jones and Singh 2006), for example, the desire to produce a memorable message, to bring about a particular response from the addressee/audience, to present a particular identity, and so on. It could well be that artistically performed language, in particular, might rarely or never exhibit methods of

easing articulation—such as recitations of certain kinds of spoken-language poetry or performances of certain kinds of sign language poetry. We can call these ‘performance language’ for ease of exposition—and we know of no studies of effort reduction in performance language.

Given the broad spectrum of activities across which the drive for ease of articulation manifests itself, we expect that all human activities that articulate parts of the body (large parts, as in running, or small parts, as in speaking) will demonstrate a drive for biomechanical ease of articulation, which should be most apparent in casual settings and as those activities speed up. This drive manifests itself naturally if there is nothing to block it, such as countervailing factors that call for a more effort-expensive choice. This expectation can, in fact, be taken as the null hypothesis; the burden of proof should be on those who claim a given activity that articulates body parts does not exhibit a drive for ease of articulation that is sometimes overridden by competing goals.

In particular, we expect dance to exhibit the drive for ease of articulation. We know of no studies that directly investigate whether or not there is a drive for ease of articulation in dance of any form (but see the discussion at the outset of [“Ease of articulation and protection of recognition of figures and phrases in participatory dance”](#) section), and there are reasons why one might initially and vehemently object to any expectation that dance would exhibit the visually-obvious, shortcutting method of effort reduction. To be sure, performative dance is engaged in by people who have trained to maintain strength, stamina, movement efficiency, and attention to articulatory detail throughout the length of a performance and, for contemporary forms of dance, at least, whose attention might, in fact, be pointedly on investigating how force and weight interact with space and time (Cunningham 1968). Performance dance could even set out to astonish—similarly to the goals of some acrobatic and ice-skating competition routines. Performance dance, then, might well rarely or never exhibit visually-obvious, shortcutting methods of effort reduction.

However, even if performance dance should, in fact, not employ shortcutting methods of effort reduction, the search for such methods in dance does not necessarily cease. Dance can take many forms and be performed in many settings—folkloric, ceremonial, line-dancing, social, ballet, tap, and more. Some of these forms are typically participatory (where we will

look below at examples from folkdance in Greece and ritualistic dance among Australian Aborigines, the Maori of New Zealand, and tribes of Mali in West Africa), while others are typically performative (where we will look below at examples from contemporary and postmodern dance as well as contemporary ballet in the USA). Participatory dance might be quite different from performance dance regarding the drive for ease of articulation. Participatory dance forms are engaged in by a cross-section of members of the community, who have differing skills and strength and who may not be particularly interested in nor give concerted attention to details of articulation. Rather, participation in dance might be part of individual and community healing, as in Senegal, Guinea, and many other African nations (Monteiro and Wall 2011); or part of (re)establishing ethnic identity, as with some Native American music and dance activities (Howard 1983); or an expression of solidarity, as with women migrant workers in Hong Kong (Lai 2010); or an outburst of joy, as in so many places around the world (Ehrenreich 2007); or a manifestation of many other personal or collective needs. The varying abilities and interests of the dancers make participatory dance a likely candidate for comparison with casual, quick conversational sign language—which also is produced by people with varying skills and strengths (including children and elderly folk with arthritis in their finger joints), who may not be particularly interested in nor give concerted attention to details of articulation. Thus, if the drive for ease of articulation does manifest itself via shortcutting methods in dance, we might expect it to be most evident in participatory dance, on analogy with casual, quick conversational sign.

Further, we expect shortcutting methods of effort reduction in dance to be somewhat similar to those in sign languages. Language and dance are produced via articulations of the body. While spoken languages use small articulators, many of which are not easily visible to others via the naked eye (think of the glottis, the pharynx, and the tongue in its various articulations within the mouth), sign languages use articulators whose movements not only are visible (arms, torso head), but must be visible, since those movements are distinctive in the addressee/audience’s determination of what sign has been produced (Stokoe 1960, and many since). Dance, likewise, uses articulators whose movements are visible, where the articulators used by sign languages are a proper subset of the articulators

available for use by dancers, thus affording us the opportunity to compare certain aspects of articulation.

The drive for ease of articulation, however, can be complicated by multiple competing factors that vary based on the particular activity and the particular individual undertaking that activity, as noted above. Here we focus on a competing factor in language that has a counterpart in dance. As Lüdtké (1980) notes with respect to language, if saving articulatory energy clashes with talking comprehensibly (that is, in such a way as to be understood), generally people opt for being understood. This makes sense: the purpose of language is communication, so the drive for ease of articulation must be constrained in order to protect/preserve that purpose (Zipf 1949; Piantadosi et al. 2011, 2012). Thus methods of effort reduction in language can apply only if the intended message remains recognizable.

In many other human activities that require articulation of body parts, the issue of recognizability does not arise. For example, in basketball we don't generally care how someone moves down the court (that is, what form their movement assumes), so long as that ball goes into the hoop.¹ In contrast, we hypothesize that the human activity of dance should be more like language in this regard; if we are to identify a dance properly, the figures and phrases of the dance should remain recognizable [where segmentation of dance movement into segments or groups is variable, but includes sensory and experiential cues as well as prior knowledge of dance (Bläsing 2015; Charnavel 2019)], even in the face of pressure to reduce effort.

In comparing dance and sign languages, however, a complicating factor often arises: music. For spoken language, the form affected is song, where the complicating effects of music on the articulation of lyrics is significant (Johnson et al. 2013). In dance, many forms are accompanied by music, where the dancer tries to make movement tempo match music tempo (Stevens et al. 2009; Styns et al. 2007). In fact, music-induced movement in general (not just dance) matches characteristics of a range of musical features (Burger et al. 2013). While we consider speed of

articulation in our study, we do not enter into examination of the relationship of music per se to articulation since such consideration is not open to comparison with sign languages but only spoken languages.

We here examine three hypotheses:

1. Dance should employ methods for ease of articulation, at least some of which should be analogous to those observed in sign languages.
2. The methods for ease of articulation in dance should be constrained by the need for recognizability, just as they are so constrained in (sign) languages.
3. These methods should be most apparent in participatory dance, just as they are apparent in casual conversation. But these methods might well not be apparent (that is, not visually obvious) in performance dance nor, possibly, in performance language, such as sign poetry.

Our examination consists of a qualitative study, comparing selected examples of articulation in American Sign Language and in a small range of dance types. Because our focus is biomechanical effort, we look at the articulators that are somewhat physically heavy: the head, arms, legs, torso. In particular, we do not consider facial or hand articulations, both of which are critical in sign languages (Pfau and Quer 2010; Brentari 2011) and in certain dance traditions (Ikegami 1971; Puri 1986), but for both of which it is extremely difficult to measure relative biomechanical effort (Napoli et al. 2014).

Restricting our study to the heavy articulators may turn out to be most appropriate in our study with respect to the issue of recognizability, as well. Recognition of movement sequences or activities requires good visual perception access—which means good lighting (Grossman and Blake 1999) and the ability to view with central vision rather than peripheral vision (Ikeda et al. 2005). Since viewers of performance dance generally have a fixed viewpoint, and cannot walk up to a moving body and circle it, viewing it from all sides [which is how Gibson (2014) describes the process of natural visual perception and recognition], sequences of articulation on the stage are most likely to be recognized as figures and phrases if they involve those articulators that are easily visually perceived from a somewhat distant and fixed viewpoint, that is, the heavy/weighty articulators.

¹ Sports competitions, such as the Olympics, are an exception: form of movement matters. Although the standards for judging form in these competitions may not be entirely transparent and objective (Looney 2004; Urquhart 2005), they are far more exacting than recognizability.

Importantly, we are not claiming that dance is a kind of language, though others have done so (Hanna 2001; and for an overview of the issue, see Hagedoorn 2010). Rather, we are working from the facts that sign languages use a subset of the articulators that dance uses, both involve capturing visual attention, both involve shared intentions (where we elaborate on what we mean by *intentions* in “[Comparison of sign and dance](#)” section), and both have participatory and performance forms.

Ease of articulation in sign language conversation

Several methods of easing manual articulation (that is, articulation of any part of the arm) occur in sign language conversation. Such methods are constrained by the need to maintain recognizability.

In “[Methods of effort reduction at the lexical level](#)” section, we discuss methods of effort reduction that apply to individual signs (that is, at the lexical level), which is the linguistic unit that the literature on ease of articulation in sign languages has focused on. In “[The need to maintain recognizability at the lexical level](#)” section, we show how the methods of effort reduction presented in “[Methods of effort reduction at the lexical level](#)” section are limited by the need to retain recognizability of the sign. In “[One method of effort reduction in compounds and at the phrasal and sentential level](#)” section, we discuss a phonological rule that reduces articulatory effort at a level higher than the individual sign.

Methods of effort reduction at the lexical level

All the methods listed here are well-supported in the literature. For details, see Napoli et al. (2014). In the examples below, we contrast a citation form (a baseline form), found in a dictionary and often used in conversation, to an effort-reduced form, which sometimes is missing from dictionaries but attested in conversation.

Weak drop (Padden and Perlmutter 1987). If a two-handed sign is symmetrically reflexive across the midsagittal plane that splits the body in half (we label such signs ‘2HMR’), one manual articulator can be dropped, particularly in casual registers (Zimmer 2000), cutting the effort in half. Generally, it is the

nondominant hand—the ‘weak’ hand—that is dropped. An example appears in Fig. 1.

Weak freeze (Padden and Perlmutter 1987). In 2HMR signs, the weak manual articulator can be held in a fixed position, while only the dominant one articulates, cutting the effort significantly. An example appears in Fig. 2.

Iteration loss (Mak and Tang 2011). Effort can be reduced by decreasing the number of repeated movements in a sign. We see no need to exemplify this with a figure.

Location undershooting (Mauk 2003). Effort can be reduced by shortening the movement so that it doesn’t arrive at the usual ending point. An example appears in Fig. 3.

Distalization (Poizner et al. 2000; Meier et al. 2008). Effort can be reduced by migrating movement to a joint more distal from the torso, where the shoulder takes the most effort to articulate (given that the whole arm moves), the elbow takes less (given that only the forearm lifts), the radioulnar takes less (given that only the forearm rotates), the wrist takes less (given that only the hand moves). An example is seen in Fig. 4.

Joint freeze (Napoli et al. 2014). Effort can be reduced in a sign that usually articulates more than one joint by simply freezing one (or more) joint. An example is given in Fig. 5.

The need to maintain recognizability at the lexical level

Many signs are iconic, in that there is a nonarbitrary relationship between form and sense (Wilcox 2000; Taub 2001). We did two brief data collection sessions with deaf signers in the Philadelphia area and the Washington, D.C. area, using the Think Aloud Protocol (TAP). TAP is a method of data-gathering developed to study the problem-solving process (van Someren et al. 1994); it has been adopted in sign language studies with respect to choices sign language interpreters make (Stone 2009), choices mimes and sign language poets make in their performances (Sutton-Spence and Boyes Braem 2013), and choices deaf signers make in creating and using taboo terms (Napoli et al. 2013; Loos, Cramer, and Napoli, forthcoming). We asked signers point blank whether they could use the various methods of reducing effort outlined above with respect to specific signs. While



Fig. 1 UGLY, two-handed (a) or one-handed (b) (from spreadthesign.com)

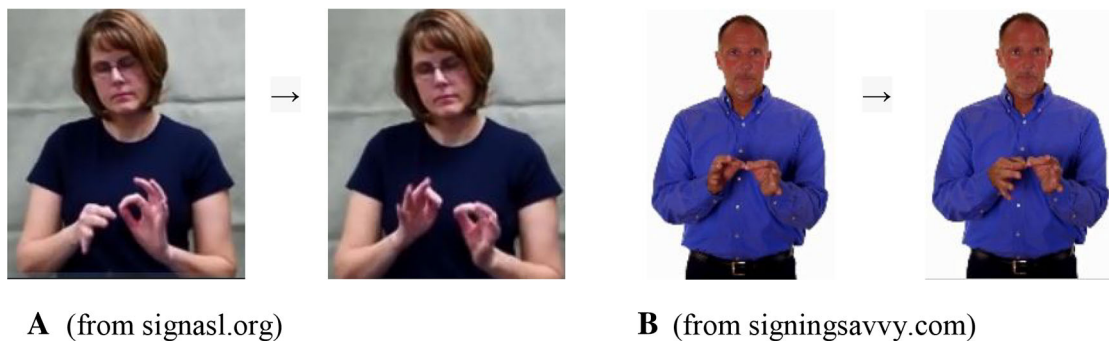


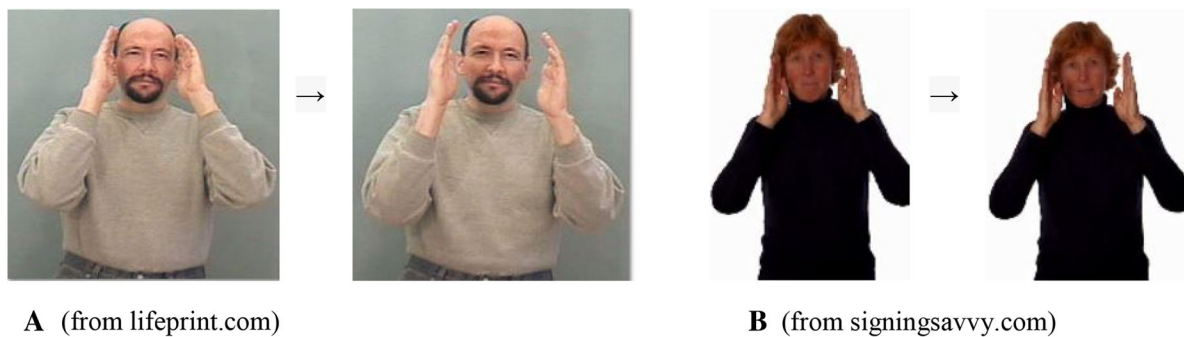
Fig. 2 INTERPRET, both manuals move (a) or only one manual moves (b)

Fig. 3 EAT/STUFF ONESELF, with hands alternating moving to the mouth (a), and moving only to below the chin (b)



A (from signingsavvy.com)

B (from Deaf Chef Paul Show #3 [youtube.com/watch?v=V6v6pWwp8jo](https://www.youtube.com/watch?v=V6v6pWwp8jo))



A (from lifeprint.com)

B (from signingsavvy.com)

Fig. 4 ATTENTION, with elbow flex (a), and with sideways wrist flex (b)

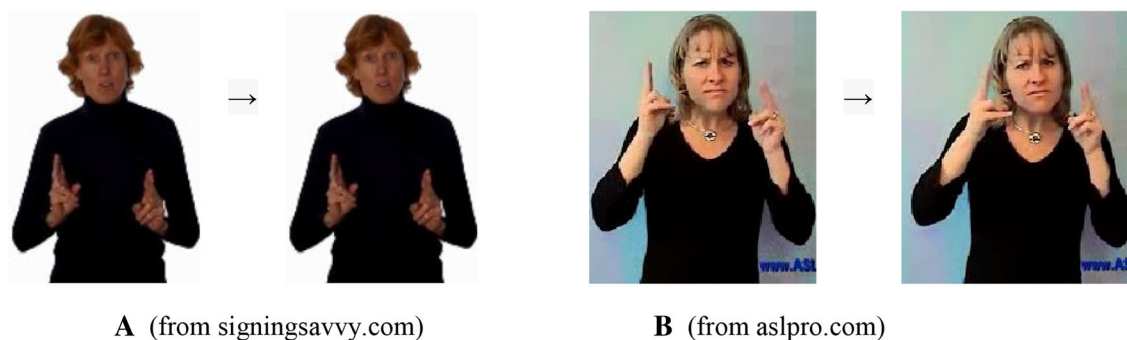


Fig. 5 RUSH, with elbow and wrist flex (a), and with only elbow flex (b)



Fig. 6 Signs that do not allow Weak Drop or Weak Freeze (both from lifeprint.com)

this study is preliminary, we have confidence in it because the reactions of the participants in the study were vehement. And, with respect to the examples we present here, uniformly consistent.

When we asked people whether they would do Weak Drop or Weak Freeze in a set of signs in which the spatial and or movement relationship between the two hands was taken to be meaningful (Lepic et al. 2016), they responded no for many signs, saying that the result of Weak Drop or Weak Freeze would be unintelligible. While our questioning was very informal and we have no statistics to present here, their responses were uniformly negative when the semantic relationship between the two hands was reciprocal. Thus no one allowed either process in the signs MEET and FRIEND in Fig. 6.

No one allowed iteration to reduce to just a single movement when iteration was a critical part of the meaning. So no one allowed it in signs like OFTEN (where each repeat corresponds to repeat in time) and FISH (where the wrist flex shows repeated body wiggle of the fish as it swims) (van der Kooij 2002, see particularly p. 79 and p. 249) in Fig. 7.

No one allowed Location Undershooting when contact with the target location was a critical part of the meaning.² Thus no one allowed it in signs like COMFORTABLE (where the hands simply must brush each other, one then the other) and FOOTBALL (the name of the sport, where the interwoven fingers look like the laces on the ball) in Fig. 8.

² Greftegreff (1992) finds that there is no distinctive difference between signs that actually make contact and those that don't in Norwegian Sign Language. Liddell (1984) claims the same for verbs like THINK and BELIEVE in ASL. But in the examples discussed in those works, the contact with the end location doesn't seem to have what we consider to be a critical part of the meaning. Compare to the signs SIT and FUCK in ASL, for example. If contact isn't made, one might well get the message that the actors got close to sitting or copulating but didn't actually realize the engagement of a completed act. Indeed, many signs which don't allow Weak Drop in ASL also don't allow Location Undershooting because of the importance of the relationship of the two hands to each other with respect to the sense of the sign. Our different findings from Greftegreff and Liddell might indicate that contact with the nondominant hand is more significant to sense than contact with other parts of the body. Further research is needed.

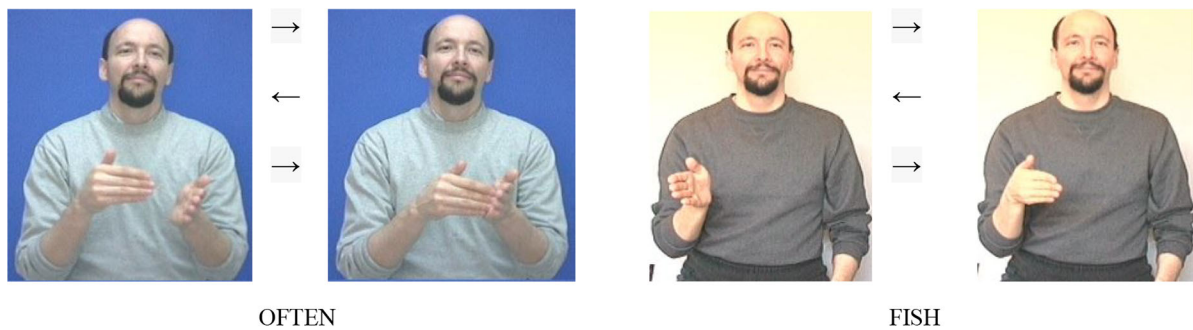


Fig. 7 Signs that do not allow Iteration Loss (both from lifeprint.com)

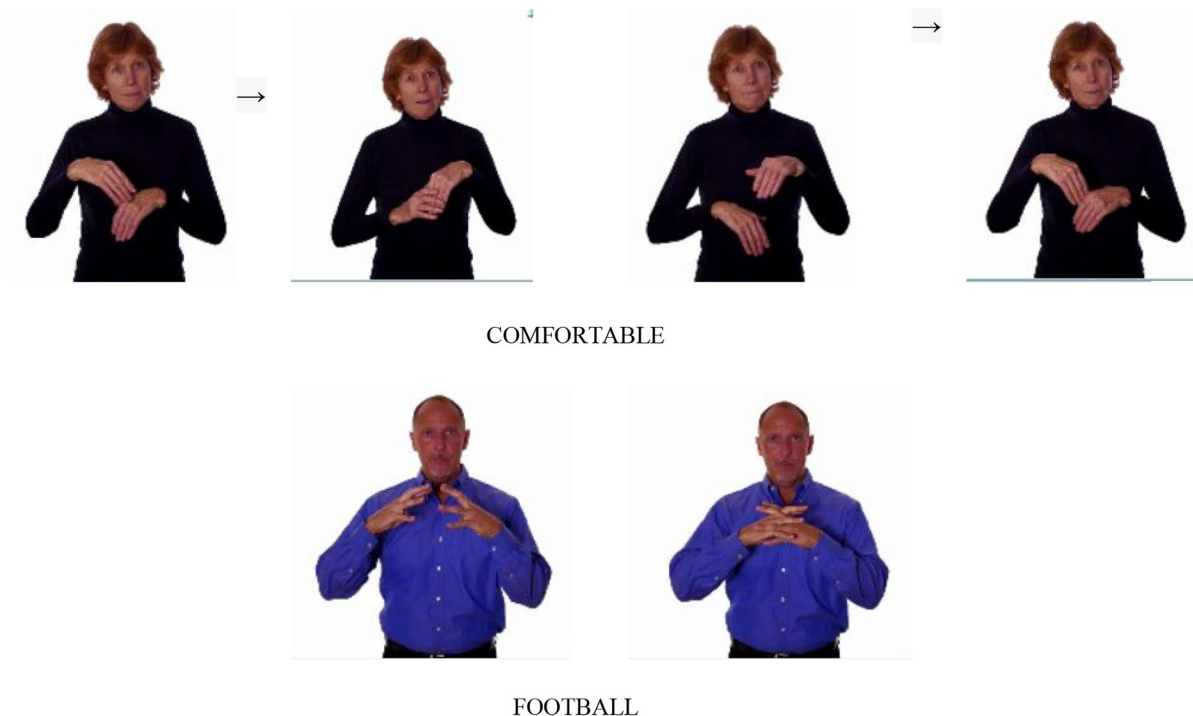


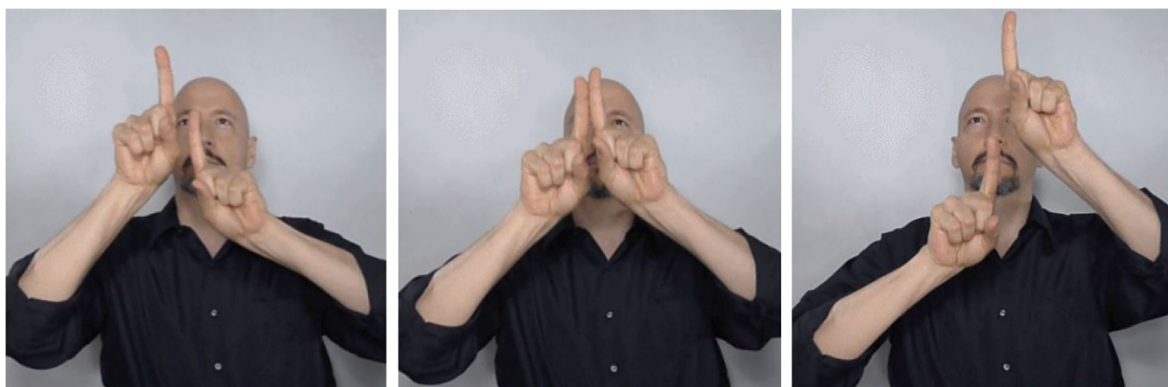
Fig. 8 Signs that do not allow Location Undershooting (both from signingsavvy.com)

No one allowed Distalization when the use of the shoulder or elbow (the joints responsible for path movement) was critical to something about the sense. Thus in *STAR* the two hands alternate moving upward, so the shoulder and elbow must be involved. And in *SAME* the hand must move between two fixed points in space, so, again, the shoulder must be articulated. Both are shown in Fig. 9.

No one allowed Joint Freeze when the freezing of that joint would result in loss of movement important to the drawing of the referent. For example, in *HOUR* in

Fig. 10, the radioulnar and the wrist articulate, so that the tip of the index finger draws the circle of a clock face, where the index finger itself can be seen as the minute hand of the clock. If the wrist freezes, leaving only the radioulnar to articulate, we lose the circle of the clock face entirely. And if the radioulnar freezes, it's impossible to move the wrist starting in a position of contact of the two hands without knocking aside the non-dominant hand.

In fact, the articulation of *HOUR* shown in Fig. 10 is awkward, and many signers proximalize movement,



STAR



SAME

Fig. 9 Signs that do not allow Distalization (both from lifeprint.com)



Fig. 10 HOUR, a variant of the sign that does not allow Joint Freeze (from signingsavvy.com)

using the elbow and shoulder joints, as in Fig. 11 (Napoli et al. 2014). Importantly, now the whole dominant hand is moving in a circular path, so the iconicity of the circular clock face is maintained.

One method of effort reduction in compounds and at the phrasal and sentential level

In fluent, casual conversation, we often see Hold Deletion (where the linguistic analysis of this phenomenon is debated; for a descriptive discussion, see



Fig. 11 HOUR, a variant that uses proximal joints (from signingsavvy.com)

Valli and Lucas 2000). Hold Deletion is a process whereby a hold at the end of a sign and, possibly, a hold at the beginning of the next sign are both eliminated (Liddell 1993). It can apply at the lexical level in compounds, such as SISTER (from GIRL plus SAME); at the phrasal level, such as in the Noun Phrase GOOD IDEA, and at the sentential level, such as in the sentence FATHER STUDIES. In Fig. 12a we see GOOD, which ends in a hold, and in Fig. 12b we see ENOUGH, which begins with a hold. In Fig. 12c we see the phrase GOOD ENOUGH, with Hold Deletion.

While a hold is not an articulation per se, maintaining the hand in a fixed position in space costs biomechanical effort. So Hold Deletion is a method of effort reduction and thus of ease of articulation overall.

Concocting instances in which Hold Deletion might not apply because of loss of iconicity is difficult. But the participants in our TAP session suggested the phrase SILENT NIGHT. There are at least two signs for ‘silent’, one that is often glossed as SHHH and one that is often glossed as QUIET. SHHH consists entirely of a hold (the index finger presses on the lips—a common gesture) and QUIET ends in a hold, where the hold for both is iconic of the lack of motion involved in the deaf equivalence of silence (Fig. 13a, b are from lifepoint.com). That is, if you are sign-language-wise silent, your manual articulators are not moving. When deaf signers name and/or perform the Christmas carol ‘Silent Night’, for example, they do not apply Hold Deletion with their sign for ‘silent’, whether it be SHHH in Fig. 13c³ or QUIET in Fig. 13d⁴ (whereas numerous

presentations on the Internet of this song in ASL by facile hearing signers do apply Hold Deletion, mistakenly, according to our consultants).

Articulation in sign language poetry

We examined a sampling of poetry in ASL (as well as in a handful of other sign languages) and found that poets vary in their diction (so to speak). They use many citation forms (which is easily verified, so we will not give examples), some casual forms that employ methods of reducing effort, and some elaborated forms that call for more effort to articulate than the citation forms. We exemplify here with the poem “Dew on Spiderweb”, created by Clayton Valli, as performed by Ella Mae Lentz, undoubtedly the most famous ASL poet.⁵ The range in articulatory forms found in this poem are representative of Lentz’ poetry performance in general (see, for example, “The Rose Bush”⁶ or “A Children’s Garden”⁷; and for multiple examples of extra effort expended, see her performance of the song “The Star Spangled Banner”).⁸

Lentz’ pronunciation of BLACK (at 0:9) in Fig. 14b exhibits Joint Freeze, in contrast to the citation form in Fig. 14a. (Note that Lentz is articulating TREE on her right hand while she articulates BLACK on her left hand.) In the citation form, we see shoulder and

³ This video is found at <https://www.youtube.com/watch?v=TxVGfKfB74>.

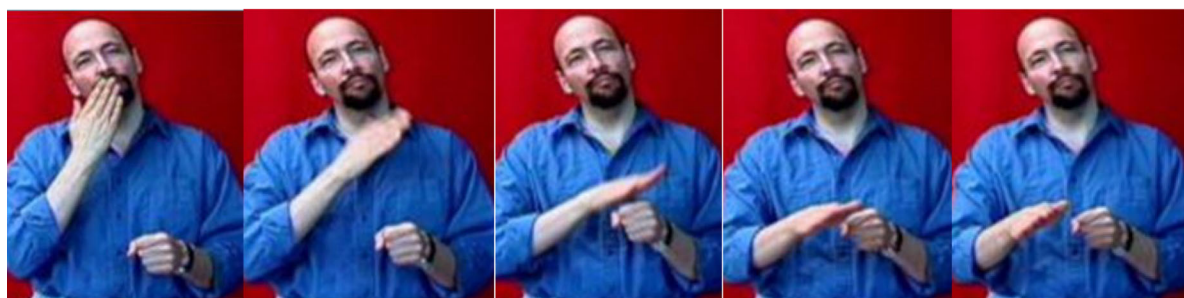
⁴ This video is found at <https://www.youtube.com/watch?v=6cio7oGLXP4>.

⁵ This video is found at <https://www.youtube.com/watch?v=YaHChvFWegQ>.

⁶ This video is found at <https://www.youtube.com/watch?v=W9biUSeHRlo>.

⁷ This video is found at <https://www.youtube.com/watch?v=iEHHU17HF28>.

⁸ This video is found at <https://www.youtube.com/watch?v=YRRWIULXPpQ>.

**A GOOD****B ENOUGH****C GOOD ENOUGH****Fig. 12** Hold Deletion in a phrase (from lifeprint.com)

radioulnar articulation. In the casual form, we see only shoulder articulation.

Another example is Lentz' pronunciation of BEFORE (at 0:21) in Fig. 15b, which exhibits Location Undershooting, in contrast to the citation form in Fig. 15a, also pronounced by Lentz, but this time in an interview.⁹ In both examples, one hand is articulating BEFORE while the other hand articulates something else. In the citation form, BEFORE stops beyond the shoulder, while in the casual form it stops before reaching the shoulder.

Finally, in this poem by Lentz we can see Hold Deletion. The sign WHITE in isolation has a hold at the end (the hand stops moving and stays in position for an instant). But in the phrase WHITE EVERYWHERE in this poem with Ella Mae Lentz, the hold is eliminated; the end point of the sign WHITE becomes the beginning point for the sign EVERYWHERE, with no instant of stillness between the two signs, as seen in Fig. 16 (0:7):

In contrast to these various methods of effort reduction, Lentz articulates with two moving hands several signs in which normally (that is, in the citation form) only one hand moves, such as EVERYWHERE/ALL-

⁹ The interview video is found at <https://www.youtube.com/watch?v=CUCN9Z1i4K8>.

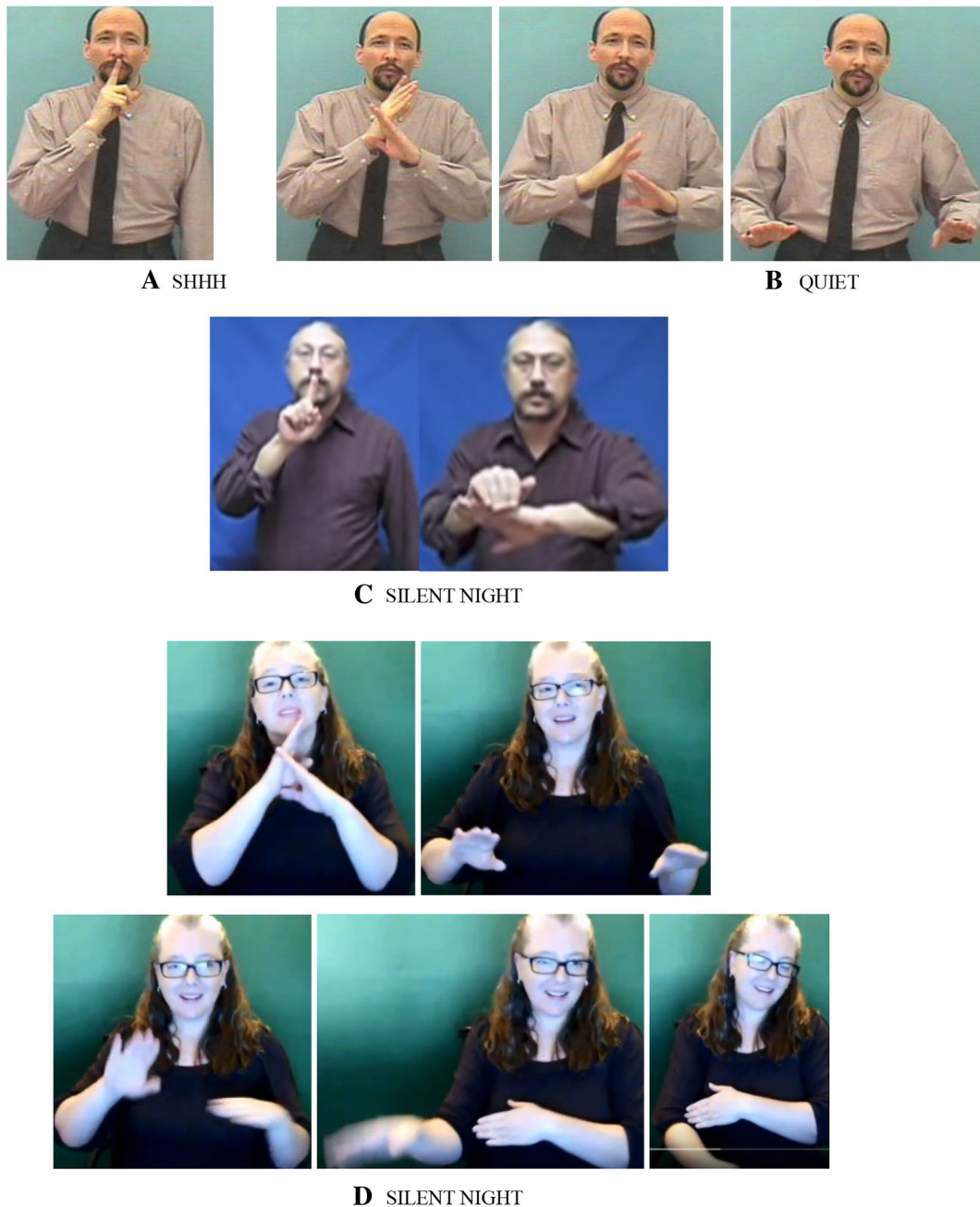


Fig. 13 A phrase that does not allow hold deletion

AROUND in Fig. 17 (0:7–8), which compares to the sign glossed as EVERYWHERE in handspeak.com (a website that does not allow its entries to be reproduced). This is, with respect to effort, the opposite of Weak Drop.

Indeed, the use of two hands for signs in which ordinarily only one hand moves is noted for British

Sign Language (BSL) poetry by Sutton-Spence (2005) and for Sign Language of the Netherlands (NGT) poetry as performed by Wim Emmerik by Crasborn (2006). Crasborn points out that Emmerik usually has both hands active in his poems, with either both moving or one fixed in a location and the other



A citation form (from signingsavvy.com)



B casual form with Joint Freeze

Fig. 14 BLACK, citation form and casual form used in a poem

Fig. 15 BEFORE, citation form used in an interview and casual form used in a poem

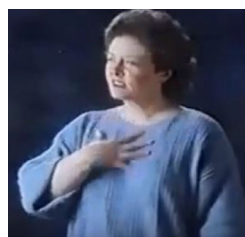


A citation form



B casual form with Location Undershooting

Fig. 16 Elimination of hold at the end of WHITE in the phrase WHITE EVERYWHERE



WHITE



EVERYWHERE



Fig. 17 EVERYWHERE, articulated with two moving hands

moving, and often with each hand expressing a different sign. He suggests this is part of a creative sign register. Our observations on Lentz' poetry are

consistent with the observations on both BSL and NGT.

Further, Lentz often articulates with longer, larger movements than normal, using that much more effort—a kind of antithesis to Location Undershooting. An example is her pronunciation of NEVER (1:17) in Fig. 18, where, once more, the left hand is articulating something else while the right hand articulates NEVER.

Additionally, Lentz articulates parts of the body that are not ordinarily articulated in making a particular sign (judging by dictionary entries). For example, in articulating TAKE-A-PHOTOGRAPH (starting at 0:24) in Fig. 19, she moves her head and torso, and lifts her arms to different points in space, mimicking taking photos from different viewpoints. This addition of

Fig. 18 NEVER, articulated in a larger signing space



Fig. 19 TAKE-A-PHOTOGRAPH, with articulation of additional body parts

articulators takes extra effort and might be a kind of antithesis to Joint Freeze.

Ease of articulation and protection of recognition of figures and phrases in participatory dance

While we know of no studies of methods to reduce biomechanical effort in dance, several studies present results that suggest the existence of a drive for ease of articulation. When people engage in popular social dance today, for example, they use “longer” (that is, covering more distance) movements if the music has slower tempos but “shorter” movements if the music has faster tempos (Styns et al. 2007; Moelants 2003), which we would expect if the drive for ease of articulation was at play. That is, speed leads to an analog in dance of Location Undershooting in sign conversation. Further, in comparisons of dance performed with and without music, dancers scaled the timing of their movements to match the dance and, when there wasn’t “enough” time, they made lapses in their articulation, to aim for “goodness of fit” (Stevens et al. 2009). This suggests analogs in dance of dropping or freezing of articulators in sign language conversations.

We also know of no studies of how one recognizes a dance figure or phrase, in particular, although there is a plethora of work on movement recognition. While any movement (such as a baseball zooming through the air) can be recognized visually without context (Snowden and Freeman 2004), recognizing a sequence of movements (as in jumping) requires knowledge. Specifically, it requires that the viewer make a linkage among movements, intentions, and effects (From 1971) by recognizing the likelihood of occurrence of that sequence of movements as a unit (bending the knees, pushing off with the balls of the feet, straightening the legs, landing with a bending of the knees again). Since humans demonstrate greater visual sensitivity to sequences of human motion than of the motion of other animals (Pinto and Shiffrar 2009), it appears that making that linkage depends, at least partially, on familiarity and, we suspect, on mentally mapping movement we observe onto our own bodies. For a sequence of movements to be recognized as a coherent activity (such as swinging one’s partner in a square dance), more complex knowledge is required, typically including attention to possible interaction with the environment and possible causal relationships, knowledge gained through experience in our own planning and executing of activities (Stränger and Hommel 1996; Bobick 1997; Prinz 1997; Hommel

Fig. 20 *Syrtaki* by semi-professional adults, slow (a) and fast (b) with width varying



et al. 2001; Pollick 2003; Blake and Shiffrar 2007). Here we used our own judgments of what constituted a figure or phrase and which articulations were most salient and, hence, if we are correct in our hypotheses, most likely to be maintained.

We looked at a handful of examples of participatory dance forms—one dance extensively (the *Syrtaki* of Greece) and then a range of dances quickly (the *Fandango Ribatejano* of Portugal and ritualistic dances of Australia, New Zealand, and Mali)—and, indeed, found evidence for a drive for ease of articulation by taking earlier articulations of a dance articulation as the baseline and comparing later articulations to that baseline. We did not have special equipment (no lycra bodysuits and no technical measures taken of tempo or articulation). Instead, we relied on the eye (as in the sign language studies we are comparing to), which is what the audience relies on in recognizing a dance figure or phrase and what the addressee relies on in recognizing a sign in a sign language.

Syrtaki dance (the dance from the film *Zorba the Greek*)

Syrtaki is a dance often performed at Greek festivals around the world, but also arises through flash mobs. There are literally dozens of videos on the Internet of people dancing *Syrtaki*, so it was easy for us to get examples from completely amateur dancers to very skilled and trained dancers. *Syrtaki* is particularly informative for us because the dance figures are repeated with increasing tempo (and see Nikolaos 2004 for a rhythmical and kinetic analysis), thus we present here a range of different methods of reducing efforts from just this one dance.

One of the most common methods of reducing effort that occurred in the videos we examined was shortening of the length of steps as the tempo of the

music increased (as expected, given Styns et al. 2007 and Moelants 2003). In Fig. 20 we see snapshots of the dance performed by semi-professionals.¹⁰ At an early point in the dance when the music is quite slow, the dancers' steps are wide and they bend their knees to varying degrees (0:14), and later, when the music is faster, their steps become much narrower and their knee bends become slighter (1:21). Reduction of step width may be analogous to Location Undershooting in sign, and the near elimination of knee bend may be analogous to Joint Freeze in sign.

These two types of articulation reduction (and, hence, effort reduction) are common. One of the figures of *Syrtaki* has one foot cross in front of the other, as the knees bend. Early in the dance when the music is slow (0:15), those steps are wide and those knee bends are deep. Later in the dance when the music is fast (1:22), those steps are narrow and the knee bends are nearly imperceptible. We see this change in Fig. 21.

Significantly for us, the dancers never just step to the side when they are supposed to cross. That is, they can lose the knee bend (a lapse that may be seen as aiming for “goodness of fit” in the sense of Stevens et al. 2009), but they cannot lose the crossing of one leg in front of the other. We take this as evidence that the leg crossing is the salient characteristic for recognizing the dance figure. We conclude that the drive for ease of articulation (here focusing on the knee bend) is constrained by the need to maintain recognizability.

Later in this same video, women cross the stage, turning on one foot with the other leg raised and bent at the knee, as shown in Fig. 22a (2:37 – 2:38). But after

¹⁰ This video is found at https://www.youtube.com/watch?time_continue=4&v=6Onu9YcDho0). The timing indications in the text are in the form of minute number, colon, then second number.

Fig. 21 *Syrtaki*, slow (a) and fast (b), with width and knee bend varying

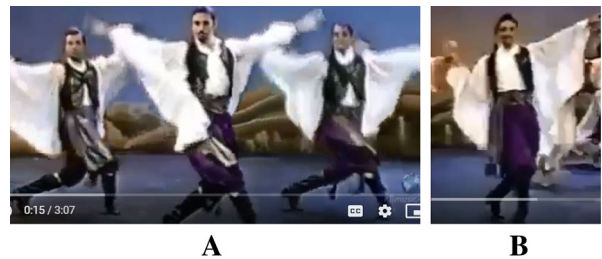


Fig. 22 *Syrtaki* series of turns, with high bent knee versus slight bent knee

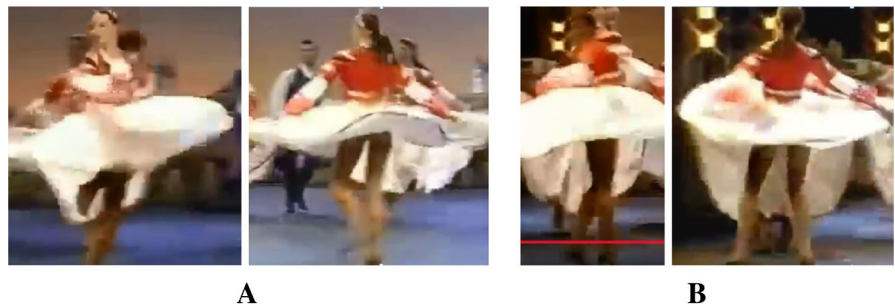


Fig. 23 *Syrtaki* kicks with varying degrees of knee cock, and of ankle and heel action



a certain point, the turns get reduced articulatorily in that the dancers do not raise the other leg, having only the very slightest knee bend needed simply for the turn, as in Fig. 22b (2:39–2:41). This particular reduction of effort might be compared to Weak Drop, and is repeated later in the dance (2:47, not shown here).

Significantly, the women do not simply step side to side off the stage, nor do they step side to side off the stage raising one leg with a bent knee. That is, they do not abandon the turn. When they reduce effort, what they lose is the raised bent knee, not the turn; the turn is the most salient part of the dance figure. Recognizability is maintained.

In a flashmob of *Syrtaki* we again find that knee action is much reduced as the dance progresses and

speeds up.¹¹ We picked out a man in a checked shirt and a woman in pink shoes beside him to follow throughout the dance, because of how easy it was to keep our eyes on that shirt and on those shoes in a crowd of dancers. In Fig. 23a (3:16) we see a kick of the left foot and then of the right foot. In this kick, the man cocks his knee high and his articulating leg is flexed at the ankle with his heel moving backward. The woman kicks vigorously, extending the kicking foot nearly as far as it can go, with little knee cock. Later, in Fig. 23b (4:04), both of them have reduced their articulation. The man's knee cock is much less sharp and his heel does not move backward. The

¹¹ This video is found at https://www.youtube.com/watch?time_continue=206&v=H5xs3ciqS8I.

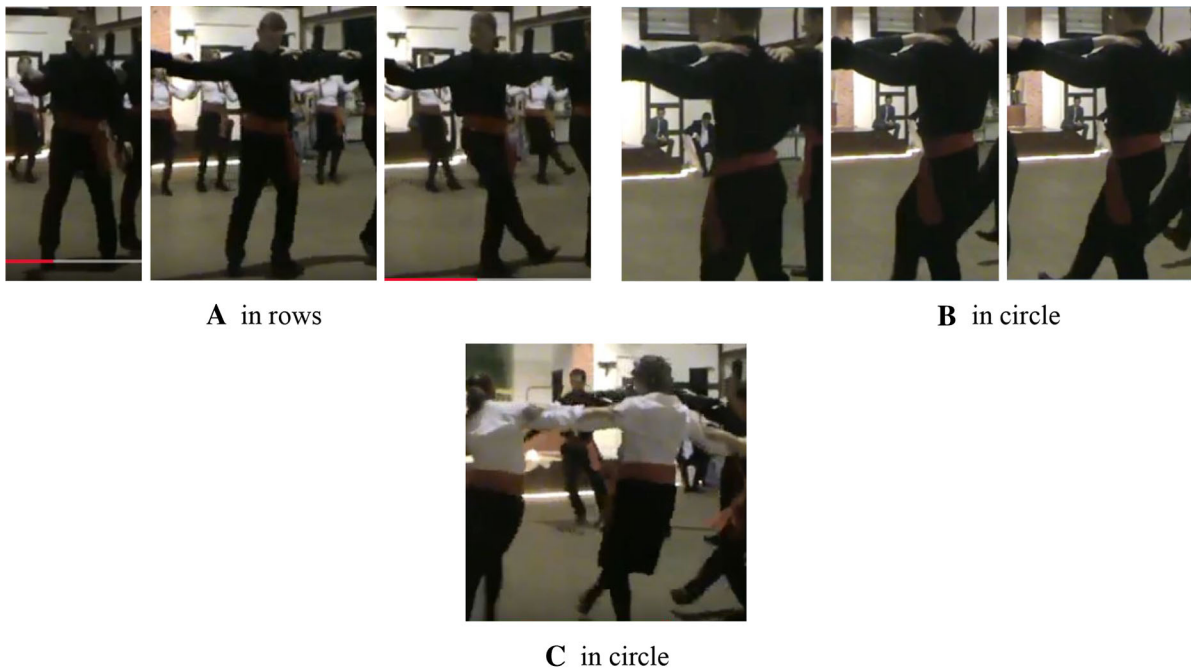


Fig. 24 *Syrtaki* step-then-kick (a and b) becomes hop-kick (c)

woman's kick is now a mild knee cock with no extension of the lower half of the leg. All these reduced articulations are analogous to Location Undershooting.

Still, they don't just hop from foot to foot, no matter how much they reduce their effort; they maintain the forward action of the lifted leg, allowing us to recognize the dance figure.

In a high school performance of *Syrtaki*, we can see another way of reducing effort in dance.¹² When the music is slow, the dancers step the left foot to the side then kick the right leg in front of it. The dancers use this same precision whether they are arranged in rows, as in Fig. 24a (2:20–2:23), or in a circle, as in Fig. 24b (2:39–2:41). But when the music speeds up, the dancers hop onto the left foot and simultaneously kick with the right foot, as in Fig. 24c (2:46).

At those fractions of a second immediately preceding Fig. 24c we do not see both feet on the ground with legs spread. That stance is lost in this figure; but the stance of one foot on the ground and the other crossed in front of it in a kick is maintained, thus the recognizability of the figure is protected. The

phenomenon exemplified in Fig. 24 might be analogous to Hold Deletion in sign.

Finally, sometimes full articulation is eliminated; that is, a dancer drops out. In one video of *Syrtaki*, an old man starts the dance, and then he is joined by many dancers.¹³ As the music gets fast, all dancers quit except the original old man and one younger man.

Another participatory dance that speeds up as it goes is *Fandango*. We did not find many videos of this dance, but in the few we found, methods for ease of articulation were, in fact, rampant. Still, these methods were not very noticeable precisely because they never obfuscated the identity of the dance figure. For example, in one video of *Fandango Ribatejano*, when the men spin, they step from one foot to the other in the early part of the dance, but as the music speeds up, more and more of them spin on just one foot.¹⁴ This may be analogous to Weak Drop.

¹² This video is found at https://www.youtube.com/watch?time_continue=14&v=9DO78mm0T4k.

¹³ This video is found at <https://www.youtube.com/watch?v=nn06m5kOaMs>.

¹⁴ This video is found at https://www.youtube.com/watch?time_continue=2&v=f0-R8-q2grc.

Fig. 25 One dancer lifts foot high early in the dance (a, b), but only barely later in the dance (c)



Ritualistic dance from various sources

We looked across a number of ritualistic dances, some of which involve dancers performing in unison, allowing for a comparison among dancers over a specific duration of time. All exhibit methods of reducing effort while maintaining recognizability of the dance figure.

In a dance during an Aboriginal Initiation Ceremony (*djapi*, the circumcision ceremony) in Numbulwar on the western Gulf of Carpentaria (Burbank 2011), some dancers used the same sorts of effort reduction methods as those we saw for dancers of *Syrtaki*.^{15,16} In Fig. 25 we call your attention to the man in the brightly colored shirt (dark blue and white stripes with splotches of red and yellow). He is second from the left edge of the photo in Fig. 25a (0:22) and he is at the left edge of the photo in Fig. 25b (0:47) and Fig. 25c (1:16). In Fig. 25a, b, he lifts his foot at least

as high as the other dancers as they stomp in the dirt. But later in the dance, he eases off, lifting his foot hardly at all, in contrast to the other dancers; see Fig. 25c (though, after a pause, he later recovers his energy). Yet, he never shuffles; he always at least minimally lifts one foot, maintaining recognizability of the dance figure as a stomp.

In another Aboriginal dance performed in 2014 at the 20th Anniversary of the Townsville Cultural Fest, a community on the northwest coast of Australia, we see differences in degree to which a knee bends to lift a foot, again.¹⁷ Additionally, we see something new. In this dance, the women often lift their heels as they do a slight squat, turning their knees to one side and then the other, and keeping their arms outstretched, as shown in Fig. 26.

In all instances of this dance figure, the knee bend is maintained, though for some dancers it is very slight; the wide arms are maintained, though one dancer keeps them at a 45° angle from the body pointing downward; and the swivel from side to side is maintained, though the dancer with the widest stance

¹⁵ This video is found at <https://www.youtube.com/watch?v=AEjMSBrFz7Y>.

¹⁶ For general reference to Aboriginal dance of the north of Australia, see Rose (2000), Magowan and Neuenfeldt (2005), and Casey (2012). For information on ceremonial behavior, see Berndt (1953).

¹⁷ This video is found at https://www.youtube.com/watch?v=1_izhyAojyg&t=584s.

Fig. 26 Dancers vary on heel lift



seems to indicate this mostly with her head and only slightly with her knees. Since the head weighs less than half of what a single leg weighs, moving the head as an alternative to the knees is, as a method of effort reduction, perhaps analogous to Distalization in sign languages.

Additionally, some dancers lose the lifting of the heel; when they swivel, they do not go up on the ball of the foot, but rather keep the entire foot in contact with the floor (or, in one case, she lifts one heel but not the other—Fig. 26d). That heel lift is the least visually salient of the moves; thus its loss does not jeopardize recognizability of the dance figure.

In a ritualistic dance of the Maori of New Zealand, we again find variation in the lifting of a foot.^{18,19} At some points in the music, the dancers kneel on one knee with the other foot on the floor, knee bent. Sometimes that front foot is supposed to stomp. The first time a stomp is called for, all dancers stomp that front foot via a full foot lift and fall, as in Fig. 27a (0:38.70). This is an extremely strenuous action to carry out, and we find that when a second stomp is called for an instant later, only some dancers lift that foot, as in Fig. 27b (0:38.78). This is analogous to Iteration Loss in sign languages. There are many

subsequent points when a foot stomp in that one-knee kneel is called for, as in Fig. 27c (0:43.14), and many of the dancers lift the foot once, but not twice, while many others do not lift the foot at all. During stomps, the arms articulate, beating the chest, and the dancers shout words, where all dancers participate in those other actions. In sum, the pose (on one bent knee) and the articulation higher in the body, and, thus, more visible, are maintained. So recognizability of the dance figure is secure, even when effort is reduced via elimination of the stomp or elimination of iterations of the stomp.

In a video of a dance from Mali in West Africa (McNaughton 2008), we see only two dancers. Accordingly, both are very aware of being in the spotlight, which may make them hyper energized. Nevertheless, this dance is particularly informative with respect to speed. The drumming starts fast, then keeps the same speed but adds extra beats between the main beats, and, finally, speeds up at the end. Like in *Syrtaki* examined in “*Syrtaki dance (the dance from the film Zorba the Greek)*” section above, the dancers have increasingly less time to perform the dance figures.²⁰ Both dancers start out lifting their knees very high, and they maintain this high lift for most of the dance, as seen in Fig. 28a (2:14). At a certain point, however, the dancer on the left lifts her knee less high

¹⁸ For general readings on Maori dance, see Youngerman (1974) and Mazer (2011).

¹⁹ This video is found at <http://youtube.com/watch?v=7TZHxb06SzE>.

²⁰ This video is from <https://www.youtube.com/watch?v=F3VAkeWvKBE>.

Fig. 27 Dancers vary on foot stomp

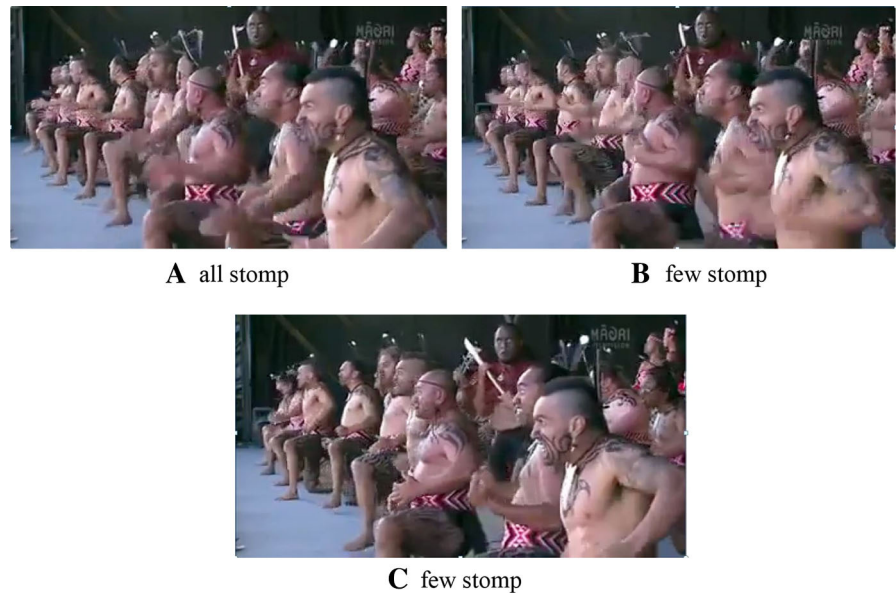


Fig. 28 Knee lift starts high, then one dancer lowers it, then the other dancer lowers it



and continues at this level from then on, as seen in Fig. 28b (2:18.79). At a late point, the dancer on the right also reduces how high she lifts her knee and continues at this level from then on, as seen in Fig. 28c (2:18.26).

Neither dancer gives up the knee raise, however. The dance figure is always clearly recognizable.

Section conclusion

Participatory dance in different cultures show similar methods of reducing effort, and, while the most common method is analogous to Location Under-shooting in sign languages, all of the methods of effort reduction in sign languages find an analog in participatory dance. Further, participatory dance imposes similar limits on those methods; recognizability is maintained.

Ease of articulation in performance dance

We searched for evidence of methods to reduce effort in several samples of well-known performance dance, all in the contemporary/modern vein, including contemporary ballet, and all in which professional dancers repeat figures often.

Christopher Wheeldon's *The Winter's Tale*—Act I Trial scene (as performed by the Royal Ballet) is a slow solo (for the most part) with many repeated figures.²¹ We did not observe any method of effort reduction, and, instead, noted passages where a repeated figure is performed with a more energetic articulation as the dance progresses—the opposite of

²¹ This video is found at https://www.youtube.com/watch?v=57bRsLf6Ph4&list=PLX0HHn2C2kU7b_khyByKDhEmQ79pUPfY.

what we expect if effort reduction is at play. We call attention to the passage starting at 3:11 and running through 3:25, in which the dancer performs a phrase three times, and the third time changes direction and holds the pose—an overall more energy-expensive articulation. David Fernandez’s *Vitruvian Man* is another example of contemporary ballet, with three dancers and many repeated figures.²² If any of these dancers uses methods of effort reduction in this performance, they are not apparent to the eye.

Kyle Abraham’s *Our Love Comes Back* is a very slow dance with lots of repetition.^{23,24} Susan Marshall’s *Arms in The Narrow Room* has varying tempo, from very slow to very fast, with lots of repetition.^{25,26} We did not observe any method of effort reduction in either of these performances.

In Doug Varone’s *Strict Love*, the music tempo is constant but the dancing speed varies.^{27,28} We found no instances of effort reduction as the dance progressed. Rather, the dancers maintain the same precision of articulation or enhance it as time goes on, where their articulation is not speed related. For example, compare the span of the woman dancer’s step in Fig. 29a (3:08) and in the repeated phrase later in Fig. 29b (5:05) (where the dancer behind her has changed dance phrase). To our eyes the span is slightly greater at the later point.

The same happens with a leg lift, but more obviously. In Fig. 30a (3:27) the leg is moderately lifted, but, later, the leg is lifted much higher, seen in Fig. 30b (5:28).

In Anne Teresa de Keersmaeker’s *Rosas Danst Rosas* we find a consistently fast tempo and very little variation in articulation.^{29,30} We saw only one

instance in which articulation was exaggerated, and that was at the very final moment of the dance, when the tempo was fastest. In this final portion of the dance, we see only one dancer, rising from a chair and descending back into it repeatedly. Her spine stays relatively straight throughout, as in Fig. 31a (1:26). But in the very last rise, she arches that spine, seen in Fig. 31b (1:31), rising and sitting faster than any other time in the dance, perhaps to signal closure, just as poetry has signals for closure (Smith 1968) and just as there are signals for closure in many different forms of music and song (Rycroft 1962; Rosner and Narmour 1992; Cook 1987; Anson-Cartwright 2007; among others).

So this dancer enhances articulation, using more effort, just as can happen in sign language poetry.

We also observed only one instance in which the dancers might have been using a method of effort reduction. There is a stretch in which the dancers rise from a chair and then sit again. Sometimes a dancer turns her head before sitting, as in Fig. 32a (1:01) and sometime she doesn’t, as in Fig. 32b (1:09).

Given that a human head weighs around five kilograms, not articulating it saves considerable effort. However, we could see no pattern to the presence or absence of head turn. So perhaps the choreographer had indicated to the dancers that head turn was simply an optional articulation.

Indeed, in strictly choreographed performance dance, the question of whether any reduction of articulation or any enhancement of articulation happens unselfconsciously poses itself. In the postmodern dance tradition (Banes 2011), this question dominates. Postmodern dance is founded on the idea that all movement is inherently dance and all people are inherently dancers. It incorporates movements of daily life and welcomes/advocates non-conventional choreography or dance composition. For example, Steve Paxton’s *Satisfying Lover* (1967)³¹ is a famous Judson Dance Theater production (Burt 2006), in which the dancers simply walk, stand, sit on chairs, and sometimes leave the stage empty for several seconds. Since the movement is pedestrian and at a slow pace, does the need to reduce effort even arise?

We consider, instead, a different postmodern dance that offers more possibility for the issue of effort

²² This video is found at <https://www.youtube.com/watch?v=NVahgdX8VWc>.

²³ This video is found at <https://vimeo.com/87132057>.

²⁴ For a profile of some of Abraham’s work, see Prickett (2016).

²⁵ This video is found at <https://vimeo.com/3824815>.

²⁶ For discussion by Marshall herself of some of the effects she tries to achieve, see Leonard et al. (2012).

²⁷ This video is found at <https://vimeo.com/250281435>.

²⁸ For a profile of some of Doug Varone’s earlier work, see Tobey (2002).

²⁹ This video is found at <https://www.rosas.be/en/productions/378-rosas-danst-rosas>.

³⁰ For a discussion of some of Anne Teresa de Keersmaeker’s thoughts on choreography, see Bräuninger (2014).

³¹ This video is found at <https://www.youtube.com/watch?v=jbbhol7o9PM>.

Fig. 29 wide span (a) and maybe wider span (b)

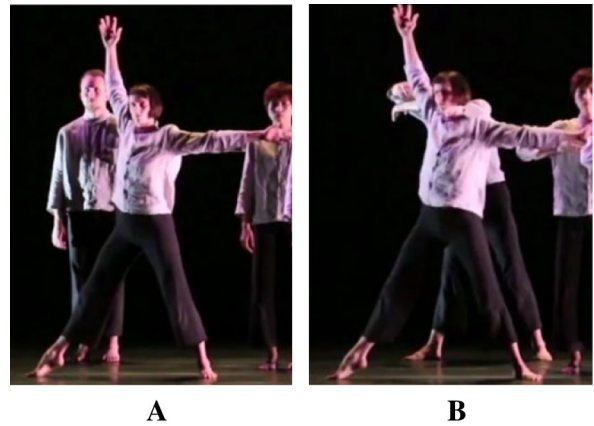


Fig. 30 moderate leg lift (a) and higher leg lift (b)

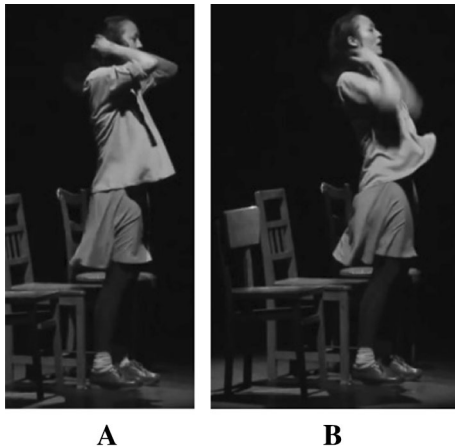
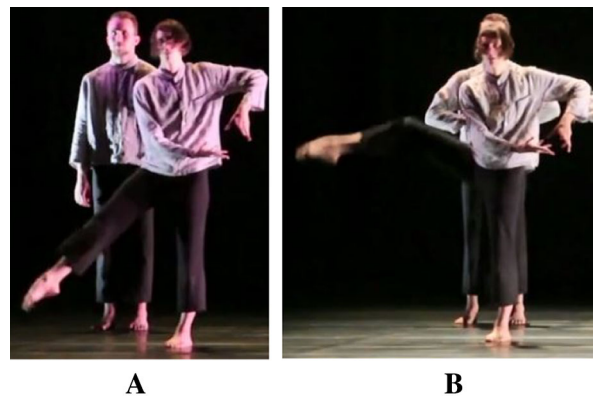


Fig. 31 straight spine (a) and arched spine (b)

reduction to arise: *Theory1:Dance*, performed by Tracy Broyles, Meshi Chavez, and Stephanie Lanckton.³² In this performance there are times when dancers walk casually, just as anyone might walk down the street, as in Fig. 33a (0:42). Then at other

times the dancers walk hanging backward or forward, as in Fig. 33b (1:13), or with high knees, as in Fig. 33c (2:00), or with high arms and/or high upper chest and head, as in Fig. 33d (2:29), or with any number of other variations—lunges and wiggly walks, some of which look decidedly pathological. The music is eerie and the dancers make groans and little shrieks throughout, a well-suited accompaniment to the movements.

Despite some of the extreme articulations, how on earth is one to know whether the drive for ease of articulation affects the dancers' articulations in such forms of dance? Even if we watched two performances of the same dance by the same dancers, we couldn't be sure that the differences in articulation between them weren't a deliberate choice by the dancers and/or the choreographer. The 'pedestrian' quality promoted by postmodern tradition has seeped into much that has

³² This video is found at https://www.youtube.com/watch?v=ub_o0IvNAN4.

Fig. 32 With (a) and without (b) head turn

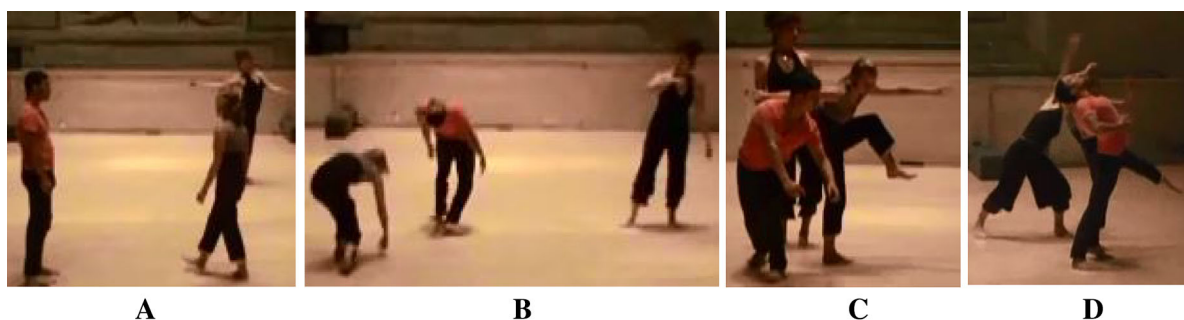


Fig. 33 Variations on walking

come after, so we find virtuosic moments coupled with an ordinary gesture or ordinary use of the joint in dance after dance.

There are a variety of reasons for which it is often impossible to know whether movements in a performance dance are reduced, from the fact that for many of the movements in modern dance pieces it is not possible to establish a baseline and from the fact that for many movements in postmodern dance pieces the very point is to use pedestrian movements. But even in the contemporary ballet pieces, we see no evidence of articulation reduction. We don't believe this is an accident. Sara Mearns of the New York City Ballet talks about the difficulty of performing a passage in Alexei Ratmansky's *Namouna, A Grand Divertissement* (she calls it “the hardest 2 min I have ever performed”) but our scrutiny of the passage led to no identification of any moment in which she seemed to be trying to reduce effort.³³ She says that Ratmansky calls her “a stage animal” and she concurs, saying,

when she's dancing, “I don't feel like I'm a human being.” Her body takes over. But she notes that in the original choreography, Ratmansky wanted her to go to the floor and “roll around” and then “end standing”, but she never made it, so he changed the ending to match what she was able to do (1:51–2:07). Of course! Choreographers can change the dance to match the abilities of the dancers, perhaps removing the places where we might have otherwise observed reduced articulation. In another video, several members of the New York City Ballet talk about the challenges they face as they grow older.³⁴ They say they work to find ways to be more “efficient”. They are aware of using methods to reduce effort, but we, the audience, cannot see the evidence of these methods. That's because they do not employ visually obvious shortcutting; the dancers do not simply reduce articulation as the dance progresses or speeds up—in contrast to what happens in participatory dance. Rather, they use their experience and maturity both in dancing and in life to

³³ This video is found at <https://www.youtube.com/watch?v=imiFrArZwvg>.

³⁴ This video is found at <https://www.youtube.com/watch?v=pFqZG2n3pR4>.

heighten the impact of some moments in the dance, allowing others to go less noticed. The dancers may be aware of somehow reducing articulation (most probably by being more efficient, as discussed earlier), but the audience is not, at least not without comparing performances by the same dancer of the same dance over a reasonable expanse of time so that a baseline can be discerned.

We believe our initial premise that performance dance will not show evidence of the drive for ease of articulation is correct. Sometimes performance dance is meant to cause awe at what the dancers' bodies can do, and sometimes not; but rarely does movement occur without deliberation and rarely does the dancer reduce an articulation (as judged in comparison to a baseline of that articulation) due to lack of strength or of stamina or of attention to details of articulation. That means that rarely will methods of effort reduction be evident to the audience.

Comparison of sign and dance

Sign conversation and participatory dance forms have in common an observable (visually obvious) drive for ease of articulation, and one that is limited by the need to maintain recognizability, as we saw in “[Ease of articulation in sign language conversation](#)” and “[Ease of articulation and protection of recognition of figures and phrases in participatory dance](#)” sections. In sign languages, this means maintaining (at least grossly) iconicity. In participatory dance forms, this means maintaining the most visually salient characteristics of the dance figure or phrase.

Sign poetry, on the other hand, can use reduced forms of signs, citation forms of signs, and enhanced forms of signs—at the will of the poet/signer, as we saw in “[Articulation in sign language poetry](#)” section. But performance dance uses only what you might call citation forms of a figure or phrase or enhanced forms, but not reduced forms, as we saw in “[Ease of articulation in performance dance](#)” section.

Thus the hypotheses we set out to test are confirmed up to a certain point. Dance does employ methods for ease of articulation, many of which are analogous to those observed in sign languages, where these methods are constrained by the need for recognizability and where they are most evident in casual conversation and participatory dance. Further, performance dance

does not show evidence of these methods. Interestingly, performance language (in the form of sign language poetry) does show evidence of these methods.

The question now is why we have such a sharp contrast between sign poetry (an example of performance language), which allows methods for effort reduction that are visually obvious (shortcuttings), and performance dance, which does not. We suggest the answer lies in the functions of these different types of language and dance.

Language is communicative by definition, and it maintains that function, whether we look at casual conversation or at performance language, such as recited oral poetry or performed sign poetry. Language, regardless of modality, has both a meaning component and an articulatory component (among other components)—which might well overlap, but which to a large extent can be distinguished from one another. Across all registers of language, recognizability is important for meaning, while methods of effort reduction are important for articulation. When we appreciate performed language, we can appreciate the interaction of these two components (meaning and articulation), as well as either of those components independently of the other. Performed poetry, for example, is speckled with shining crystals of beauty, and those crystals can be due to the meaning or to the articulation or to a combination of the two. A poet, whether in spoken language or sign language, need not rely on articulation in order to get across all the beauty and thrust of the poem; some moments may be stunning purely because of what they mean regardless of qualities of the articulation.

Participatory dance, like language, has a personal and/or community function, and, again, within that function it is possible to distinguish intention (which we will discuss below—but for now, please interpret this term as analogous to *meaning* or *purpose*) from articulation to a large extent. The intention of a ritualistic dance, for example, can be understood even if the dancers are somehow compromised in their articulation—they are mourning, or honoring, or pleading for help, or celebrating success, or whatever. Likewise, other intentions of participatory dance—expressions of identity, emotion, solidarity—can be understood even if details of articulation among the dancers might vary.

This is not true of performance dance, where understanding intention is inextricably intertwined with perceiving articulation; any change in articulation comes with a change in meaning/intention. Let us explain. *Intention* is a concept debated in the dance literature (Van Dyke 2001; Pakes 2017) just as the concept *meaning* is debated in the linguistics literature, and its understanding/role in dance may be unique; Stevens and McKechnie (2005, 243) say that the expressive nuance, feeling and communicative intent of dance is “not characteristic of other movement-based procedural tasks”. Intention is, indeed, intricately related to expressivity (Arnheim 1965, 363) and involves, at the least, all the supporting factors of the articulation, including what the dancer may be thinking about, how the dancer arrives at a pose (even if it’s instantaneous arrival and departure), where the dancer may go next, and how one dancer relates to other dancers. Intention is an observable reality, even though it is neither objective nor easily defined; basically, you know it when you see it [a standard that is ineffable and problematic, yet used in the courts with respect to obscenity (Marshall 1985)].

Importantly, performance dance has no intention independent of articulation. A photograph of an instant in a dance tells us nothing about the intention of the dancer(s)—because all we have is a pose, not a movement, not an articulation, not a sequence of articulations. Consider the gesture of raising an arm, in the Trisha Brown dance *Glacial Decoy*, which has no music.³⁵ The early section of the dance is a duet of two women. In Fig. 34a (0:54) the dancer with the braid raises her arm by holding it straight and moving it from down at her side to in front of her and up to vertical. In Fig. 34b (0:55) the other dancer does the same. Without seeing the articulation of both of these arm raises in sequence, we do not know that one dancer echoes the other. In Fig. 34c (0:58) the dancer with the ponytail repeats this same arm raise, a little less quickly and with more determination. In Fig. 34d (0:59) the braided dancer does the same, and closes her fist. Immediately, after that, the dancer lowers her fist straight down, allowing the elbow to flex. Again, without seeing the articulation of both these arm raises from their initiation to the lowering again after Fig. 34d, we do not recognize the closing of the fist

as an action of ‘catching’ and then keeping what the other dancer has thrown.

In Fig. 34e (1:19) the hand moves straight up vertically and slowly, with both elbow and wrist flexion. Without seeing the articulation leading into this stance, one cannot recognize it as stable. In Fig. 34f (1:22) the straight arm (on the dancer on the left) raises from the rear, causing a torque that throws the dancer’s torso forward. Here the relatedness of the raised arm and the bent torso is unknown without seeing the articulation. In Fig. 34g (1:25) the raised arm is at the apex of a turn, where the arm has been flung up from the ipsilateral side and around to the rear, causing a torque that promotes the turn. None of the dynamics is clear from just a snapshot of the pose. In Fig. 34h (1:26) the arm raises straight and slowly up from the front, then it falls slowly to the ipsilateral side. Slow movement of arms is more controlled and less likely to cause torque; but the pose itself can’t show that. On and on it goes: in Fig. 34i (1:33) the arm comes up from the rear; in Fig. 34j (1:37) the left arm of both dancers is flung up and across the front of them in a diagonal from the contralateral side, causing a torque that throws the dancers’ torsos to the side; and in Fig. 34k (1:42) the arms move straight up, with an elbow flex and extension. The point is, the pose itself tells us nothing about the intention of the figure or phrase it belongs to, because the pose is isolated from the sequence of movements that lead up to it and the sequence of movements that follows it. In sum, intention cannot be teased apart from articulation.

Articulation can, however, be (nearly) free of intention; a notation of a dance, such as in Labanotation (Hutchinson 1954/1991) gives us indications only of articulation. We can read that notation and reproduce the articulations of the dance. Nevertheless, we cannot comprehend intention in that articulation until we see the dance performed (and it could have different intentions depending on the different interpretations that dancers imbue it with).

In participatory dance, intention is very much shared by the dancers—and might be raw emotions, such as joy, enthusiasm, defiance, or grief, or might be ordinary encounters, such as greeting or flirting in an American square dance or in traditional English, Irish, and Scottish country dances (Hast 1993). Having an audience is not critical to participatory dance; what matters is being part of the community of dancers.

³⁵ This video is found as <https://www.youtube.com/watch?v=42ggqDdlrKI>.

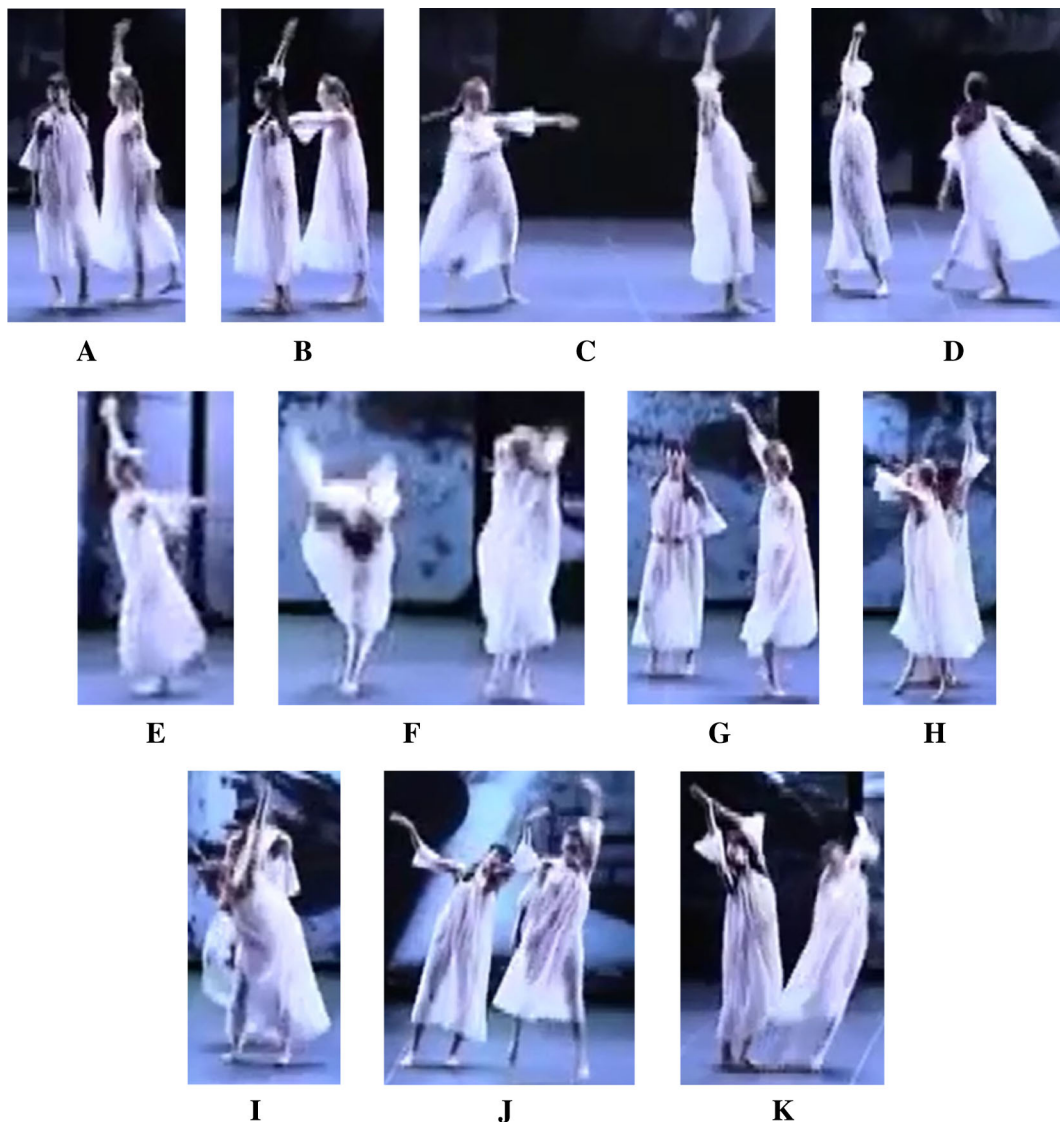


Fig. 34 Arm raises of varying types

In performance dance, in contrast, each dancer may have an intention in each articulation. And having an audience matters, for the dancer/choreographer may well want to have a certain effect or impact on the audience, perhaps telling a narrative [as in Mongolian dance (Pegg 2001)], or evoking a set of emotions [as in Argentine tango (Savigliano 2018)], or breaking societal barriers and dispensing with preconceptions [as in people in wheelchairs dancing (Albright 1997)]. Further, the choreographer may have a purely abstract intention, such as moving the form of the art forward (Blumenfeld-Jones 2008). That is, whether or not there

is anything to ‘get’ may not be as much a concern to the choreographer as whether or not something is possible, or new, or ‘works’. Thus the shining crystals of beauty that speckle performance dance cannot help but involve articulation—in contrast to the jewels of poetry. All of that means that the performance dancer must remain exquisitely aware of details of articulation; no effort reduction methods will be employed without deliberation. In particular, shortcutting of articulation will not occur unless it is chosen—it will not be the result of lack of strength or lack of stamina or giving into other energy pressures, such as those

imposed by increasing speed—in which case, it is, arguably, not really shortcutting, or not in the sense of shortcutting in participatory dance or in language. The articulations of a performance dancer are, to the eye of the audience at least, precisely what the dancer aimed to do; if a movement is pedestrian or if a moment is a reduction from the baseline, that's because the dancer chose to do something pedestrian or reduced.

Conclusion

We set out to explore whether the drive for ease of articulation evident in sign language conversation is evident in dance, since the articulators in sign languages are a subset of those used in dance. We divided dance into two broad types—participatory and performative—then we cast our net even wider, and looked not only at both types of dance but also at sign language poetry, which we offered as a possible analog to performative dance. Our conclusions suggest that the purpose of the articulations affects the extent to which signers and dancers are likely to employ methods of effort reduction. Sign languages, whether in conversation or in poetry, aim to be understood, but so long as that aim is achieved, variations in articulation can be acceptable. Participatory dance aims to engage a range of participants with varying skills and strength; so as long as the dance remains recognizable, variations in articulation can be acceptable. Performance dance aims to capture an audience, so it will protect the integrity of articulation (where the dancer's and/or choreographer's judgment of integrity is the relevant one if no baseline is available), no matter how demanding of effort that articulation may be.

Still, there is more to learn from this study. Acceptability of articulation is not the only relevant measure. Sign language poetry, like dance, has artistic intention, and there are moments when artistic intention cannot be conveyed in its entirety without seeing the performance in its dynamic whole. Sign poetry, then, shares with performative dance an artistic component inseparable from the articulation itself. Thus, sign poetry walks the fence. It shares with conversational signing and with participatory dance those aspects of meaning that are conveyed via conventionalized forms of articulation. And it shares with performative dance those aspects of intention that

are conveyed via non-conventionalized creative forms of articulation.

Given this duality of sign language poetry, we searched for possibilities of duality in performance dance. One might suggest marking as a candidate. Marking is a strategy in teaching and rehearsals in western performance dance traditions whereby one drastically reduces articulation, often transposing movement from legs to arms. Importantly, marking is not part of a performance, but, rather a placeholder for something else more important (the performance itself) that will happen in the future. Warburton et al. (2013) explain that marking:

can be considered representational rather than just miniaturized performance. One common example is using a finger rotation to represent a turn while not actually turning the whole body. These kinds of strategies may allow dancers to physically rehearse some aspects of the performance (e.g., timing, head and arm movements, or movement qualities) and mentally rehearse other aspects (e.g., the choreographic sequence, with the turn represented in the appropriate place in the sequence) while eliminating altogether the need to allocate attention to still other aspects (e.g., maintaining balance during a turn or reorienting oneself in space after a turn).

In some cases, marking minimizes movement to reduce physical effort in order not to tire the dancers. This is permissible precisely because, in these teaching and rehearsal situations, the audience is not present, thus the effect on the audience that full articulation has is not the focus. The main aim of marking is as a tool for learning, rather than an energy saver. Marking is a means to create space for physical and mental patterning, allowing the dancer to attend cognitively to particular aspects of a movement or phrase. We are left then with seeing performance dance as not dual in nature, but, instead, uniquely bound to articulation.

In a range of other studies, the application of linguistic methodologies and theories to the analysis of dance has proven to offer insights into articulation across these two distinct types of activities and, more broadly, into human cognition (Ramesh 2013, 2014; Napoli and Kraus 2015; Charnavel 2016; Patel-Grosz et al. 2018). In the present paper we use information about how the drive for ease of articulation is realized in sign languages to analyze how it is realized in dance. This study, then, like the other

studies on linguistics and dance, is part of an emerging sub-field of linguistics called Super Linguistics, in which formal linguistic methodology is applied to the analysis of objects other than languages. For discussion of this emerging sub-field, we refer the reader to the Super Linguistics website at the University of Oslo.³⁶ Two of the areas that have received the most attention so far are music (Lerdahl and Jackendoff 1983; Rebuschat et al. 2011; Rohrmeier 2011; Katz and Pesetsky 2011; Katz 2017; Schlenker 2017), and gesture (Giorgolo 2010; Tieu et al. 2017, 2018; Schlenker 2018), areas that dance has been studied alongside of, particularly with regard to matters of computational modelling (Camurri et al. 2003) and perception (Naveda and Leman 2010). We hope here to have contributed new insights that might prove useful in understanding language and dance with respect to modelling and perception. In particular, we have offered a functional (goal-oriented) account of why differences in the reduction of biomechanical effort are expected across these two domains. We have also focused attention on the existence and importance of the notion of recognizability in language and dance, a notion that might be fruitfully applied to studies of variation and historical change in sign languages and participatory dance.

Acknowledgements We thank the attendees of the first lecture in the Super Linguistics series at the University of Oslo, in January 2019, as well as Molly Flaherty, Emily Gasser, Nafisa Essop Sheik, and Jonathan Washington, for comments on initial versions of this work. We are heavily indebted to the three reviewers of this article, whose comments helped us understand the issues here much better and both reshaped and enriched our arguments.

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³⁶ <https://www.hf.uio.no/iln/english/research/groups/super-linguistics/index.html>.

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