

Fun with Bokola

A traditional string figure from Fiji

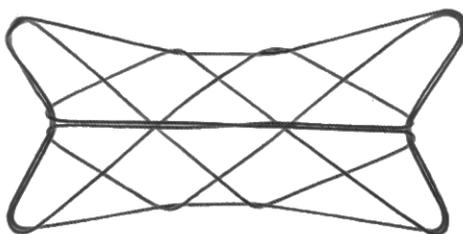
by

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ABSTRACT

Two major processes drive the evolution of string figures: technique sharing and friendly competition. It is well established that new designs emerge when methods for making existing designs are altered. But deciding how to alter a method requires special insight that can only be acquired through trial and error, or from others. In this article four string figure artists collaborate to create novel variations of Bokola, a traditional figure from Fiji. Each artist makes a unique contribution to the group by sharing techniques gleaned from years of experience.

J. Murphy: On Christmas Eve i visited Joe Ornstein for his annual blast. We began talking about the first times we met. He did most of the talking since i had no memory of the first time.

i had been invited to give demonstrations of string figures by the Clearwater group organized by Pete Seeger to publicize the need to clean up the Hudson River. There was an American Indian emphasis by the group that year and the Museum of the American Indian had identified me as a traditional artist using strings. This was around 1983 to the best of my recollection.

i was assigned my time periods to demonstrate and was told that i was to be placed in the storyteller's area for want of a better fit in the other performing

arenas. So there i was explaining my ten men system to all who cared to slow down and watch. During my down times i tended to crochet strings for my students, especially since the fall semester was to begin in a couple of weeks and i had to have at least 100 strings ready for my new students. At the time i knew no other way to make strings.

As Joe tells it i was sitting on the ground crocheting strings when he approached after having watched one of my presentations. i told him that the best way to get started on string figures without a dedicated teacher was to buy a copy of Jayne's book and learn from her as i had done. He thanked me profusely and went on his way. He said i barely looked up from my needlework.

The next time we met i remember clearly. i was presenting a 3½ hour presentation at the Leonhardt People Center of the American Museum of Natural History in New York City. Its title was "STRING FIGURES: The traditional art of creating patterns with string," and i was identified as Cherokee. My old friend Bill Cuellar was in an adjacent room discussing Cherokee and Iroquois crafts, and he was also identified as Cherokee. We had a two day gig Saturday and Sunday November 11 and 12, 1989.

i was welcoming all the people who showed up and asked them all the same question, whether they had brought a string. Then i gave them one and turned to meet the next group. One of the last people to show up was Joe.

Imagine my surprise when he opened his coat and showed a bandolier of strings looped across his chest. So i asked him to show me a figure and he did! It was a beautiful mesh that i was not familiar with (fig. 1). Joe said he discovered it while fooling around with a Fijian figure called *Bokola*, which he found in Hornell's book.

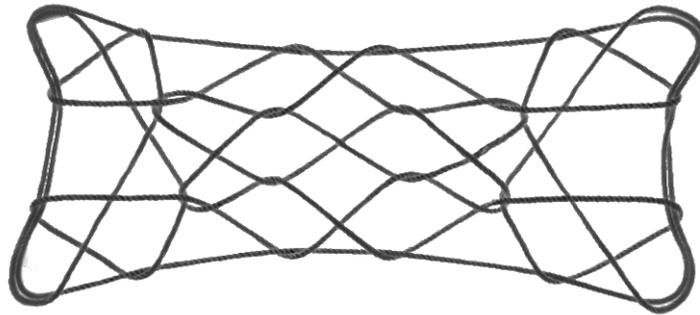


Fig. 1 - *Mystery figure created by Joe Ornstein*

J. D'Antoni: That's right. Joe Ornstein played a lot with *Bokola*. He devoted an entire chapter to it in an unpublished booklet he gave me called *Funipulations*. All of the figures in the booklet are described using a symbolic code he devised that is very easy to learn. Maybe we should start by reviewing how the Fijians make *Bokola*. Then we can tackle Ornstein's method and his variations.

Fijian Bokola (Hornell 1927:30-31)

1. Opening A.
2. Transfer the index loops to the middle fingers and the thumb loops to the indices.
3. Catch the index radial between the lips midway between the hands, draw it out; take the left mouth string on the conjoined index and middle finger of the right hand; similarly take up the right mouth string on the index and middle fingers of the left hand, going proximal in each case. Release string held in the lips.
4. Transfer the little finger loops to the conjoined index and middle fingers.
5. Navajo separately the loops on the indices and middle fingers by lifting the single loop on each over the two which are common to both fingers.
6. With the index and thumb of the right hand grip the loops on the index and middle finger of the left hand at a point close to the palmar side of these digits, lift off both loops, turn them over through 180°, and then, without disturbing the loops, replace them thus turned, upon the thumb and index respectively. Proceed similarly with the corresponding loops on the right hand.
7. Extend the resulting figure upon the thumbs and indices, turning the palms downwards (fig. 2).

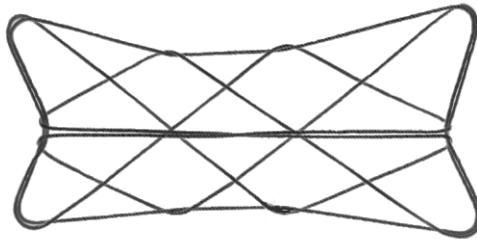


Fig. 2 - Fijian Bokola

Hornell writes: "The figure thus obtained shows two median strings running from hand to hand above a network of regular meshes. The median strings represent the pole from which is suspended a human body (represented by the network beneath) carried as the natives sling a dead pig — the wrists and the ankles tied together."

According to Hornell, "The word *bokola* has no equivalent in English. It signifies a human being brought to a town or village as the spoil of war, either to present to the local religious chief (at Mbau the *Roko Tui Mbau*) for sacrifices or to feast a party of distinguished visitors or allies."

Hornell concludes with a remark about the figure's distribution: "This figure is identical with the Marquesan *tataiahue*, a species of fragrant plant (Handy 1925:35-36).

M. Sherman: I believe I've seen this figure in collections from South America as well.

J. D'Antoni: Yes. In fact, Ornstein's method for making the figure is closely related to a Karajá Indian method reported in last year's *Bulletin* (Whan 2002:176). Each method produces the same final form, but there are differences in the fine structure of the string crossings. Here is the Karajá method, followed by Ornstein's method:

Duck Beak Fish (Karajá Indians, Brazil)

1. Opening A3: (Opening A; release 5 loop and extend).
2. With 5 pick up 2f and return to create palmar strings.
3. With R3 pick up the left palmar string and return. Pass L3 distally through the R3 loop, pick up the right palmar string, and return.
4. 1, over all intervening strings, picks up 5n.
5. 5, over all intervening strings, picks up lower 1f.
6. Pass 2 and 3 toward the center over the double palmar strings and insert these fingers distally into their own loops. Pinching 2f and 3n between the tips of 2 and 3, release the double 1 loops and double 5 loops and extend on hooked 2 and 3, pulling the double palmar strings in opposite directions so that the loops on the backs of 2 and 3 slip off.
7. Proximally transfer the hooked 3 loop to hooked 5. Rotate 2 toward you and up to display the figure (fig. 3).

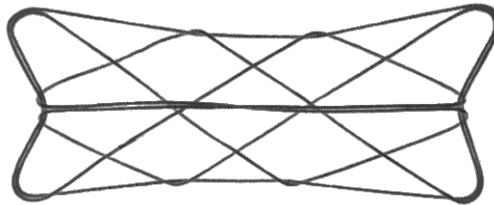


Fig. 3 - Duck Beak Fish

Ornstein's Bokola

(Editor's note: A key to Ornstein's symbolic code is appended to this article).

(A5)
 (A); Rπ fX; H→Mπ←HMP;
 ←HMTT H→MP

Translation

- Opening A5 = Opening A; ring finger picks up far index string; right middle finger picks up left middle finger palmar string; Left middle finger picks up right middle finger palmar string (fig. 4).

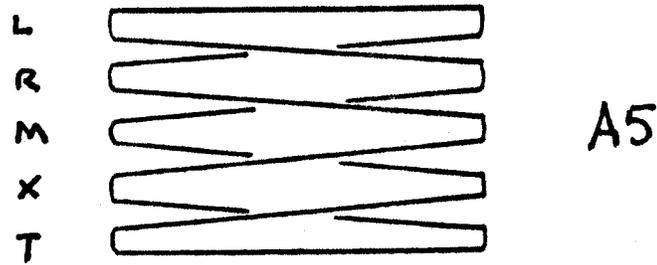
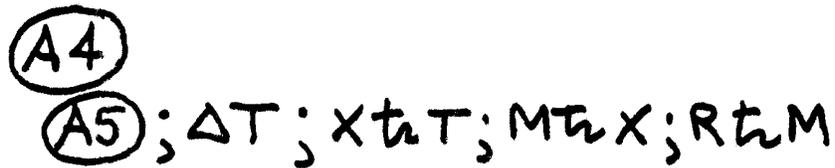


Fig. 4 - Opening A5

*Translation*

- Opening A4 = Make Opening A5; release thumb loop; transfer index loop to thumb; transfer middle finger loop to index finger; transfer ring finger loop to middle finger (fig. 5).

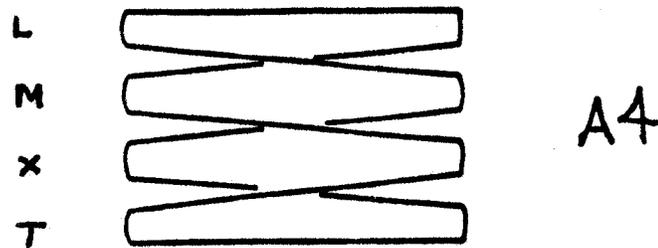


Fig. 5 - Opening A4

$\textcircled{A4}$;
 $\textcircled{\otimes} \frac{T}{X\uparrow, M\uparrow}$; $T T T n L$; $\frac{L}{X\uparrow, M\uparrow}$; $L T T f T$
 X, M hook down P $\Sigma \Sigma$ thru
 their respective $\uparrow \uparrow$
 $\Delta T L \textcircled{\otimes}$
 NOTE: $\textcircled{\otimes}$ to $\textcircled{\otimes}$ is the STANDARD
 BOKOLA ENDING

Translation

1. Opening A4.
2. Thumb, over index and middle finger loops, picks up near little finger string.
3. Little finger, over middle and index loops, picks up far thumb string.
4. Index and middle fingers hook down palmar strings through their respective loops.
5. Release thumb loop and little finger loop. [Raise index to extend] (fig. 6).

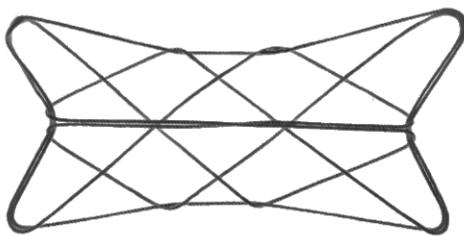


Fig. 6 - Ornstein's Bokola

J. D'Antoni: Ornstein calls steps 2 through 5 the *Bokola Ending*. Over a dozen variations of *Bokola* are described in *Funipulations*, but I suspect that this is only a small percentage of what Ornstein discovered during his explorations. Here are the codes for his variations:

Variation 1 (fig. 7)

$$\textcircled{A4}; \rightarrow T; \rightarrow L; \frac{1}{2} \rightarrow X; \frac{1}{2} \rightarrow M$$

Variation 2 (fig. 8)

$$\textcircled{A4}; M \text{ tr } T; X \text{ tr } M; dT \text{ tr } X$$

Variation 3 (fig. 9)

$$\textcircled{A4}; \rightarrow T; \rightarrow L; \frac{X}{nM}; X \pi f M; NX$$

Variation 4 (fig. 10)

$$\textcircled{A4}; \frac{X}{nM}; X \pi f M; NX; \rightarrow T; \rightarrow L$$

$$\frac{1}{2} \rightarrow X; \frac{1}{2} \rightarrow M$$

Variation 5 (fig. 11) [Note: A4 (R, M) = Opening A4, omitting M tr X; R tr M]

$$\textcircled{A4} (R, M); R \frac{1}{2} \rightarrow \text{tr } X; \frac{1}{2} \rightarrow M;$$

$$\rightarrow T; \rightarrow L$$

Variation 6 and 7 (fig. 12 and fig. 13)

$$\textcircled{A4}; \rightarrow T; \rightarrow L; \frac{T}{nX}; \frac{fX}{T}; M \downarrow nM$$

$$\frac{T \pi nM; \Delta M; X \text{ tr } M; dT \text{ tr } X}{\text{-----}}$$

(variation may continue as:

$$\frac{1}{2} \rightarrow X; \frac{1}{2} \rightarrow M)$$

Variation 8 (fig. 14)

JOE'S SUNSET
 (A4); $\frac{X}{nM}$; XTTFM; NX

Variation 9 (fig. 15)

FIJIAN BOKOLA
 (A4) · M, X ω L; Δ L; M, X ω T;
 Δ T; NX; NM

Variation 10 (fig. 16) [Note: (X,R only) = Δ M, before or after Bokola Ending]

(These end — **BOKOLA (X, R ONLY)**)

(A5); R \uparrow M \downarrow T; X \uparrow M \downarrow R;
 dT \downarrow X; \downarrow T; \downarrow L

Variation 11 (fig. 17)

(A5); X, R ω M

Variation 12 (fig. 18)

(A5); M \downarrow W; R \downarrow T; X \downarrow R;
 dT \downarrow X; $\frac{1}{2}$ \downarrow X; $\frac{1}{2}$ \downarrow R;
 W \downarrow M; T \uparrow M; L \uparrow M;
 \downarrow T; \downarrow L

Variation 13 (fig. 19)

(A5); R \uparrow M \downarrow T; X \downarrow R; dT \downarrow X;
 X \downarrow M; \downarrow T; \downarrow L

Variation 14 (fig. 20)

$(A5)$; $R \uparrow M \neq T$; $X \downarrow M \neq R$; $d T \neq X$;
 $\circlearrowleft T$; $\curvearrowright L$

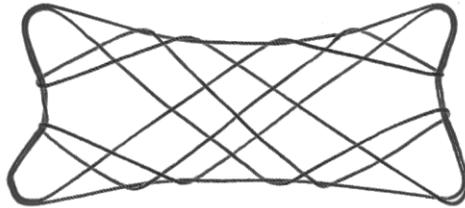


Fig. 7 - Variation 1

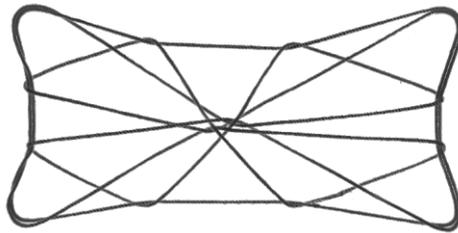


Fig. 8 - Variation 2

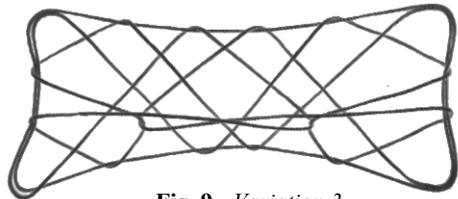


Fig. 9 - Variation 3

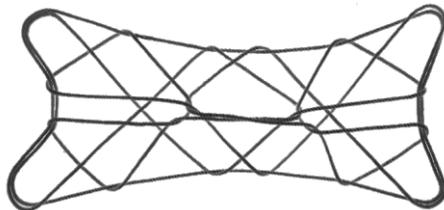


Fig. 10 - Variation 4

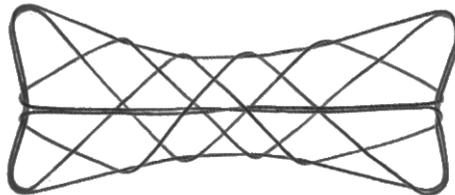


Fig. 11 - Variation 5

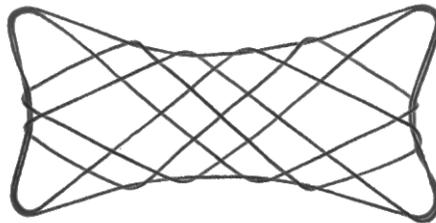


Fig. 12 - Variation 6

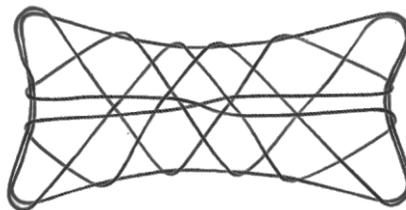


Fig. 13 - Variation 7

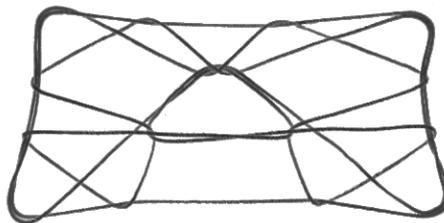


Fig. 14 - Variation 8

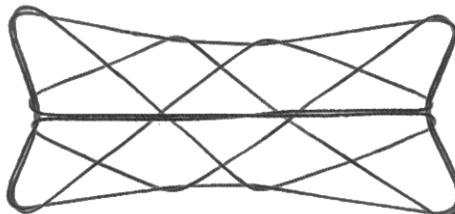


Fig. 15 - Variation 9



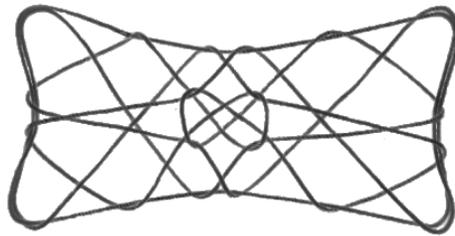


Fig. 16 - Variation 10

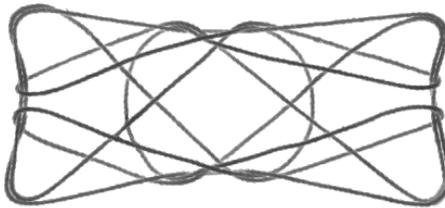


Fig. 17 - Variation 11

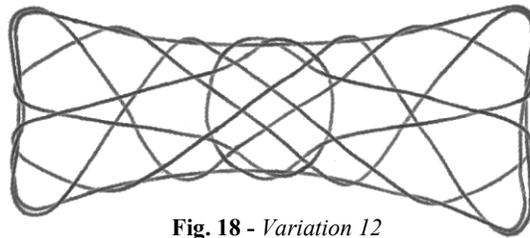


Fig. 18 - Variation 12

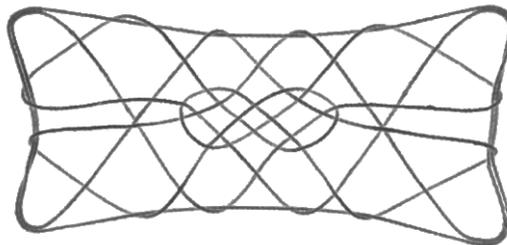


Fig. 19 - Variation 13

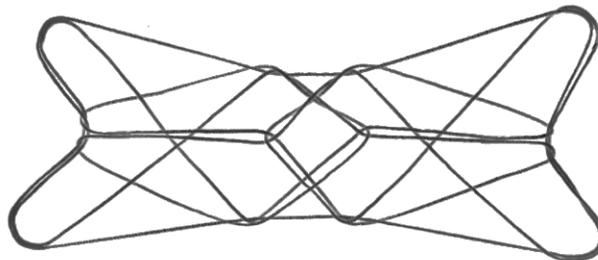


Fig. 20 - Variation 14



M. Sherman: I like the way he modified the method to accommodate a five-loop version of Opening A in variations 10-14. “These end – Bokola (X, R only)” must mean that index and ring fingers hook down palmar strings through their respective loops during the *Bokola Ending*. Is the middle finger loop released during the extension?

J. D’Antoni: Yes, that is my interpretation.

M. Sherman: But how about the figure he showed James Murphy back in 1989? It’s similar to variation 6, but has interesting triangles at each corner.

J. D’Antoni: The same triangles appear at two corners in the variation he calls ‘Joe’s Sunset,’ so he must have done something similar. In ‘Joe’s Sunset’ the triangles are created in the step just prior to the *Bokola Ending* where Joe uses his index to pick up a string which he then Navajoed.

J. Murphy: Yes, that is the key. Since the triangles appear at all four corners, it is clear that he picked up a string with his index and Navajoed, then picked up a string with his middle finger and Navajoed. Here is an approximate reconstruction based on Ornstein’s instructions for variation 6:

1. Opening A4.
2. Rotate thumb loop a full turn away from you; rotate little finger loop a full turn towards you.
3. Thumb passes over near index string and under far index string while middle finger pushes down near middle finger string; thumb picks up near middle finger string (and returns through index loop).
4. Release middle finger loop.
5. Transfer index loop to middle finger.
6. Transfer distal thumb loop to index finger.
7. Middle finger picks up near little finger string; Navajo middle finger loops by lifting near middle finger string up and over the tip of the finger.
8. Index finger picks up far thumb string; Navajo index loops by lifting far index finger string up and over the tip of the finger.
9. Push wraps toward center of figure to elongate the finger loops.

Now do the Bokola Ending:

10. Thumb, over all strings, picks up near little finger string.
11. Little finger, over all strings, picks up far thumb string.
12. Pass index and middle finger over doubled palmar strings and insert them into their own loops, folding them over their own palmar strings.
13. Release double thumb loop and double little finger loop. Extend by pulling clutched palmar strings in opposite directions (loops on the back of index and middle fingers will slip off). Display with index pointing up and middle finger pressed against the palm (fig. 21).

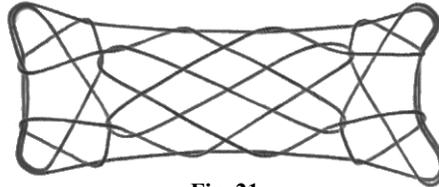
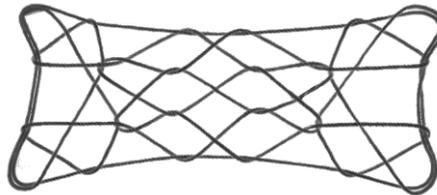


Fig. 21

M. Sherman: Brilliant! Everything is the same except for the absence of four wraps near the center of the figure.

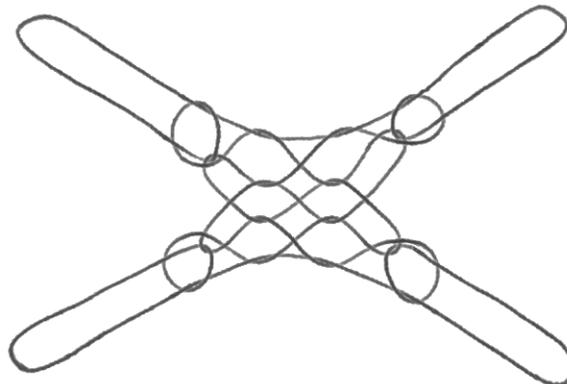
J. Murphy: These are introduced by repeating steps 3-6. The complete sequence would be: steps 1-6, steps 3-6, steps 7-14 (fig. 22).

Fig. 22 - *Ornstein's First Figure*

M. Sherman: That's it! That's the first figure Ornstein showed to you when you met again in 1989.

J. Murphy: Yes. i call it "Ornstein's First Figure" in my notebooks. As i recall, he created a second figure by partially dissolving the first figure:

14. On each finger release (do not Navajo) one of the two loops, retaining the loop that feeds into the transverse frame strings; separate the hands slowly and gently until the second figure forms (fig. 23).

Fig. 23 - *Ornstein's First Figure partially dissolved*

M. Sherman: Looks like a turtle — four legs and a shell covered with diamond-shaped tiles.

J. Murphy: Joe Ornstein is a fount of new ideas for me to play around with. His inventiveness is unique in my experience. I only wish that my left hand was stronger. I have trouble extending Ornstein's First Figure because of a high school football injury. On my hands, the figure tends to collapse and misflower.

M. Sherman: Me too. It seems that many figures are "string specific," meaning that the extension is influenced by string length (relative to its diameter) and string texture (coarse versus smooth). When I first worked through Ornstein's *Bokola* variations I used a nylon 1½ span string that was 1mm in diameter, but for some I needed a longer string, or something with more friction like cotton cable cord. It's largely a matter of trial and error.

J. D'Antoni: As of late, I have been studying different methods for extending a string figure, and I think the following may help: After sloughing off strings, hooked 2 and hooked 3 hold the final figure. In preparation for the extension, from the fingertip side transfer 2 loops to 1, and 3 loops to 5. Hands are now in a normal position. Then use one of the following two methods to display the figure:

Method I: Give 5 loops a full rotation away from you, and 1 loops a full rotation towards you. The finger holds mimic the completed 'Apache Door' (Jayne 1906:12-16), and reap all its benefits, namely, a wide figure with a central design that does not collapse no matter how hard the strings are pulled (fig. 24).

Method II: Wind double 5n strings around 5, and double 1f strings around 1 (fig. 25). This method, functionally, preserves the central design as Method I does.

The downside of both these methods is that they change Joe Ornstein's original figure by introducing extra twists where the fingers hold the exterior.

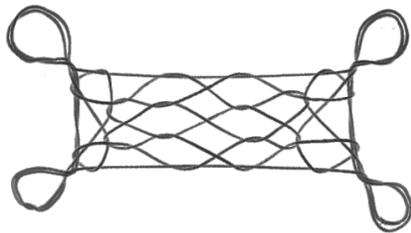


Fig. 24 - Method I extension

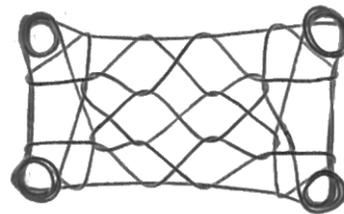


Fig. 25 - Method II extension

M. Sherman: Method II is very effective! Another possible solution would be to wind only one of the two strings: transverse 1n and transverse 5f (fig. 26). The practice of winding transverse strings to keep them from slipping reminds me of the method used for extending 'Flying Fox' in the March 1998 issue of *String Figure Magazine*, and 'Andromeda Galaxy' in the September 1996 issue, both of which collapse unless something is done to anchor the frame lines. Also, it's about the only way to effectively extend all those horrid 'Two Trees' variations I described in Bulletin no. 17 (1990). Richard Darsie recently asked me for permission to include some of them on his revamped web site (www.darsie.net/string/), but I confessed that they really don't turn out as illustrated unless the 1n string is wrapped around 1 to secure the upper frame line.

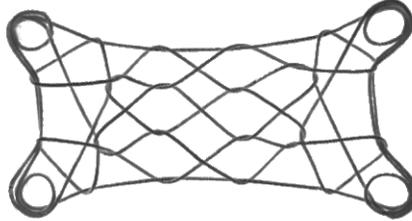


Fig. 26 - Method III extension

J. D'Antoni: Yes, I suspect that many nice patterns have been overlooked simply because the maker didn't know how to display them properly.

M. Sherman: Let's continue to play with Ornstein's First Figure. Perhaps we can rationally design some new patterns. James, how do you go about creating variations of a newly encountered figure?

J. Murphy: I begin by reducing their construction to a series of loop passages, which I record using my "circle notation" (Murphy 2000:244-247). Here's how I form the core of Ornstein's First Figure:

Murphy's rendition of Ornstein's First Figure

1. 4-loop L-DNA loom (Murphy 2000:219-220; loop on little fingers; left middle finger hooks up near little finger string then shares its loop with right middle finger; left index hooks up near middle finger string then shares its loop with right index; left thumb hooks up near index string then shares its loop with right thumb).
2. Middle finger loop up through index loop and return.
3. Transfer middle finger loop to index and index loop to middle finger (i.e., with the opposite hand lift off the middle finger loop, transfer the index loop to the middle finger, and place the original middle finger loop on the index finger).
4. Middle finger loop up through index loop and return.
5. Transfer middle finger loop to index and index loop to middle finger.
6. Rotate thumb loop a full turn towards you; rotate little finger loop a full turn away from you.

You will note that i introduce the loop rotations at the end of the sequence, and that i prefer to rotate the loops in the opposite direction compared to Ornstein's method because it is easier for my hands to accomplish. This merely alters the direction of the wraps along the frame lines. Complete the figure using Ornstein's method:

7. Middle finger picks up near little finger string; Navajo middle finger loops by lifting near middle finger string up and over tip of middle finger.
8. Index finger picks up far thumb string; Navajo index loops by lifting far index finger string up and over the tip of the index finger.
9. Push wraps toward center of figure to elongate the finger loops.
10. Thumb, over all strings, picks up near little finger string.
11. Little finger, over all strings, picks up far thumb string.
12. Index and middle fingers pass down into index and middle finger loops and clutch the double palmar strings.
13. Release all loops except the clutched palmar strings. Raise the index to separate it from the middle finger and extend the figure (fig. 27, chart 1).

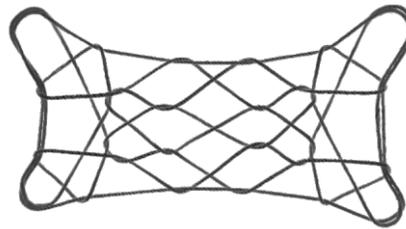
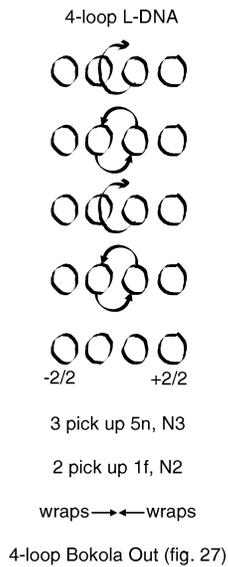


Fig. 27 - Murphy's rendition of Ornstein's First Figure

Chart 1

Since the *Bokola Ending* (steps 10-13) is used as a finishing technique for displaying the inner complexity generated by the loop passages, i use the term *Bokola Out* in my circle notation charts to emphasize the fact that it terminates the weaving process.

The first variation is to isolate the ending and the derivative figure by omitting the loop passages (steps 2-5):

1. 4-loop L-DNA loom.
6. Rotate thumb loop a full turn towards you; rotate little finger loop a full turn away from you.
7. Middle finger picks up near little finger string; Navajo middle finger loops by lifting near middle finger string up and over tip of middle finger.
8. Index finger picks up far thumb string; Navajo index loops by lifting far index finger string up and over the tip of the index finger.
9. Push wraps toward center of figure to elongate the finger loops.
10. Thumb, over all strings, picks up near little finger string.
11. Little finger, over all strings, picks up far thumb string.
12. Index and middle fingers pass down into index and middle finger loops and clutch the double palmar strings.
13. Release all loops except the clutched palmar strings. Raise the index to separate it from the middle finger and extend the figure (fig. 28, chart 2).

4-loop L-DNA

 $-2/2$ $+2/2$
 3 pick up 5n, N3
 2 pick up 1f, N2
 wraps → ← wraps
 4-loop Bokola Out (fig. 28)

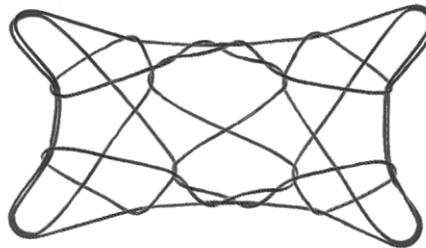


Fig. 28 - *Ornstein's First Figure with loop passages omitted*

Chart 2

The continuation figure resembles an 'Hour Glass':

14. On each finger release (do not Navajo) one of the two loops, retaining the loop that feeds into the transverse frame strings; separate the hands slowly and gently until the second figure forms (fig. 29).

A third figure is made by rotating the top half of the figure 180° clockwise while maintaining the bottom half. This undoes the string crossing at the center of the figure (fig. 30).

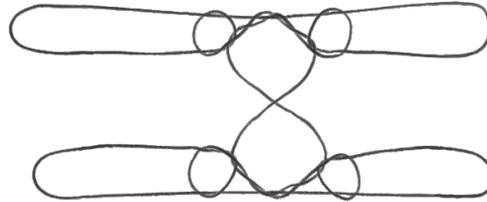


Fig. 29 - Continuation figure

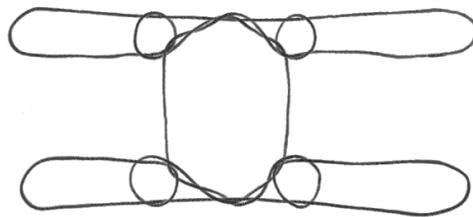
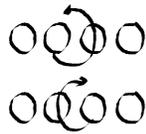


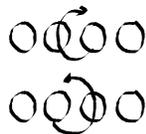
Fig. 30 - Continuation figure with central crossing removed

M. Sherman: Nice! Looks like a bearskin rug.

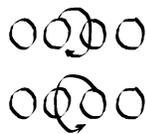
J. Murphy: i mentioned that the center weaving of Ornstein's First Figure intrigued me because it opened up further thoughts concerning the four loop tennis nets i explored in a previous article (Murphy 2000). My center weaving for that figure was:



and its alternative:

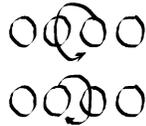


or down instead of up:

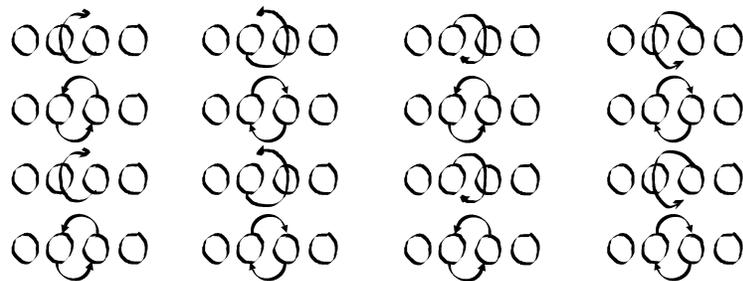




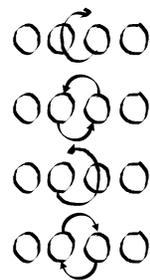
and its alternative:



Similar transformations can be applied to Ornstein's center:



Note that bastard pairs may be used in the four steps that form the center:



etc., which is to say that the initial center weaving possibilities are richer than i had imagined.

M. Sherman: Do the continuation (derivative) figures differ as well?

J. Murphy: No. All these variations yield this same derivative figure when sloughing the outer loops top and bottom (which i found out by a series of identical photos even though the figures were different in their appearance before sloughing).

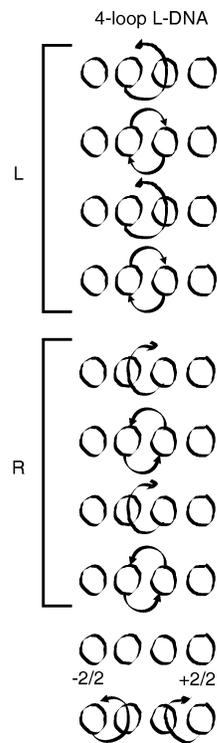
J. D'Antoni: In your opinion, what is the most attractive feature of Ornstein's *Bokola* and its variations?



J. Murphy: Ornstein’s figure is interesting because it provides a different framework to display complexities introduced in the beginning weaves of four-loop figures. Previously i used *Inuit Out* to finish off my four-loop explorations (Murphy 2000:222-225). Furthermore, unlike the *Inuit Out* figures, all of his *Bokola* figures are “magical” when they are disentangled by pulling the centers of the two transversals. They slither apart quite readily.

J. D’Antoni: Have you studied the effects of performing different moves with each hand?

J. Murphy: Yes i have, and the results are somewhat surprising. For example, the following sequence produces a beautiful figure with a double wrap encased in a central diamond (fig. 31, chart 3):



4-loop Bokola Out (fig. 31)

Chart 3

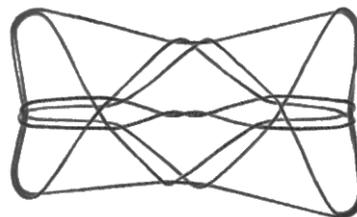


Fig. 31 - Double wrap variation

M. Sherman: *Bokola* and its variations have double loops on each of the four fingers that are used to extend the design. One of the strings of each double loop is transverse, while the other runs toward the center of the figure. This reminds me of Nauruan figures that end with the *Amwangiyo* sequence (fig. 32). Unfortunately this configuration limits our ability to produce a wide extension. Applying more tension does not seem to help. Nauruans invented the *Nauru Ending* to circumvent this problem. The *Nauru Ending* converts the double loops to single loops and eliminates the double palmar strings (fig. 33). Once this is accomplished the Caroline Extension can be applied, or any other extension technique that anchors the frame lines and separates them. Can a similar procedure be applied to figures in the *Bokola* series?

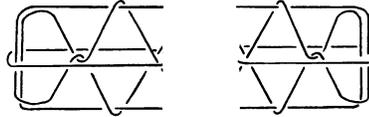


Fig. 32 - Side motifs of a figure that ends with *Amwangiyo*

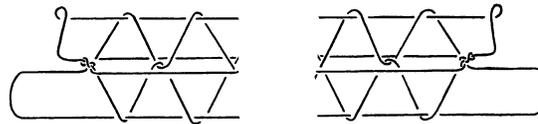


Fig. 33 - Side motifs of a figure that ends with the *Nauru Ending*

J. Murphy: Yes. In my North American Net article (Murphy 1999) I call this procedure *fixing the bottom* and *cleaning the top*. Here's how to apply the procedure to fig. 31:

- With bent index and middle finger pointing towards you, transfer double index loop to the thumb, inserting the thumb distally.
- Index picks up the oblique near thumb string, then hooks up the transverse near thumb string (oblique is freed).
- Release double thumb loops.
- Transfer double middle finger loop to the thumb, inserting the thumb proximally and from the far side.
- Transfer index loop to the little finger, inserting little finger from above.
- Index picks up oblique near thumb string, then hooks up transverse near thumb string (oblique is freed).
- Release double thumb loops and extend with fingers pointing away (fig. 34).

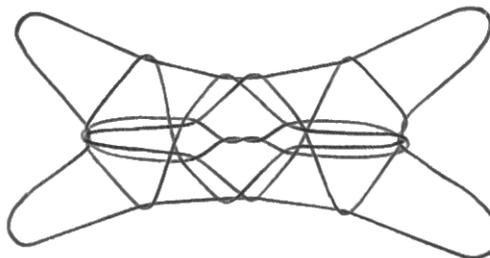


Fig. 34 - Double wrap variation fixed and cleaned

The figure is especially attractive when made with an octagonal two-color loop (fig. 35). i call it an octagonal loop because it consists of eight equal length segments joined together so that the two colors alternate (Murphy 2000:248). i then form the L-DNA loom and adjust the strings so that the color changes fall on the backs of the fingers (fig. 36).

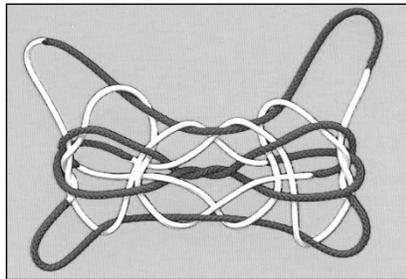


Fig. 35 - Double wrap variation made with an octagonal loop.

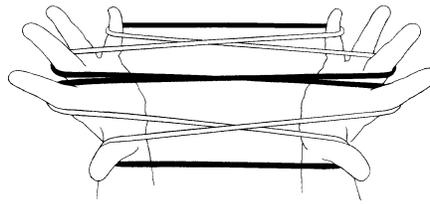
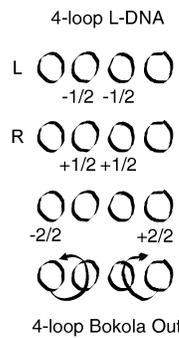


Fig. 36 - 4-loop L-DNA loom made with an octagonal loop.

J. D'Antoni: What happens if you replace the loop passages in the core sequence with loop rotations?

J. Murphy: Something very interesting happens. For example, try the following sequence (fig. 37, chart 4):



Fix bottom, Clean top (fig. 37)

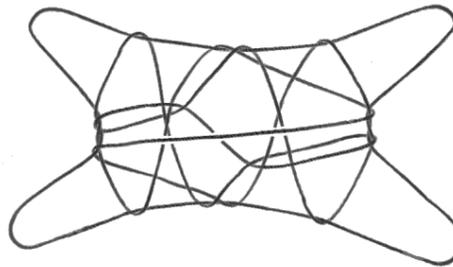


Fig. 37 - left -1/2, -1/2, right +1/2, +1/2

Chart 4

Like *Bokola*, you have a medial string that runs from hand to hand across the surface of the figure. But rather than two medial strings, you have only one. If you reverse the direction of the index and middle finger loop rotations, the medial string is no longer free, but is caught by the central diagonal string (fig. 38, chart 5). You might want to try forming the same figures starting with the

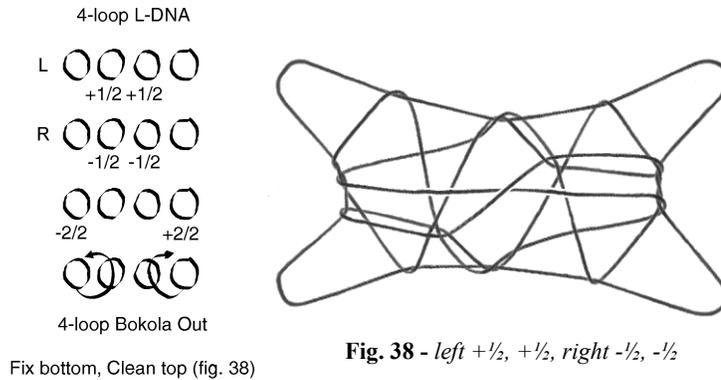


Chart 5

R-DNA 4-loop loom. I'm beginning to understand a little more about the interior wrappings of a four-loop figure, especially with this new ending framework.

M. Sherman: I was wondering what would happen if the index and middle finger loop rotations matched on each hand rather than being opposite in direction, so I tried the following and got a very pleasing design (fig. 39, chart 6):

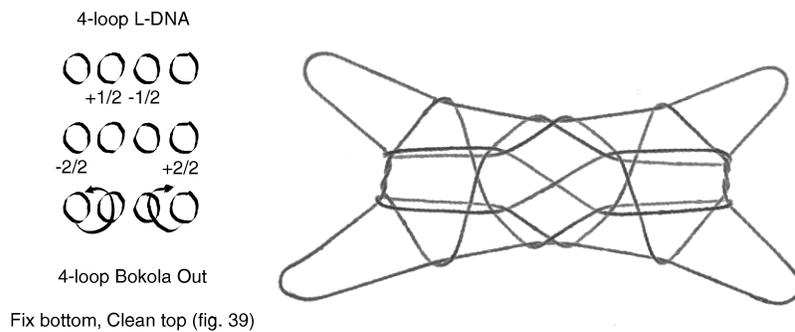


Chart 6

The central motif reminds me of fig. 840 in Jayne's book, which represents a beautiful Nauruan woman named *Egarawinago*. I therefore call this figure 'Egarawinago's Daughter.'

Next, I tried to adapt this sequence to a five-loop loom, much like Ornstein did in *Funipulations*. Again I got a very pleasing design (fig. 40, chart 7):

5-loop L-DNA

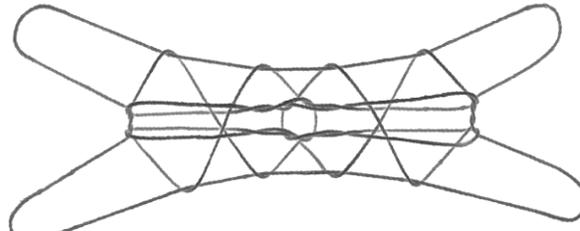
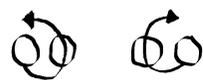
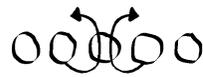
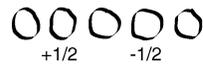


Fig. 40 - Navel Orange

4-loop Bokola Out (4 replacing 3)

Fix bottom, Clean top (fig. 40)

Chart 7

The central diamond is sort of round like an orange, and in the center there is a small circle (a navel!) that forms when the middle finger loops are released. I therefore call this figure 'Navel Orange.'

J. D'Antoni: 'Egarawinago's Daughter' and 'Navel Orange' are beautiful. Let me suggest a modified ending to your figures which provides for a wide extension, and makes each figure look like a painting mounted in a picture frame. It is a method I alluded to previously. Proceed until you have finished with bending your fingers over the palm strings and releasing the 1 and 5 loops. Instead of *fixing the bottom* and *cleaning the top*, perform the following:

- From the fingertip side, transfer 2 loops to 1, and 4 loops to 5, hands in normal position.
- Wind double 5n around 5, and double 1f around 1. Pull taut.

J. Murphy: i would never have thought of the five-loop drop off figure with the navel in the center, but i did notate the figure you call 'Egarawinago's Daughter' two weeks ago. i often leave out parts of what I've done, sometimes on purpose and sometimes because i mislay scraps of paper. But the three of us have moved beyond the "politics" of who discovered what.

M. Sherman: I agree. Given that 99% of figures created in antiquity were never written down, it really is silly for someone to claim that they "discovered" a new string figure. I think "stumbled upon" is a more accurate term!

J. Murphy: Getting back to the figures: i think 'Navel Orange' could yield some interesting variations. For example, if you introduce a left dominant switch (Murphy 2000:274-280) on the middle finger loops after the 5-loop L-DNA opening, the center changes significantly (fig. 41, chart 8). For added pleasure i finished the figure with the *Two Diamonds Ending* (Murphy 1999:188-189).

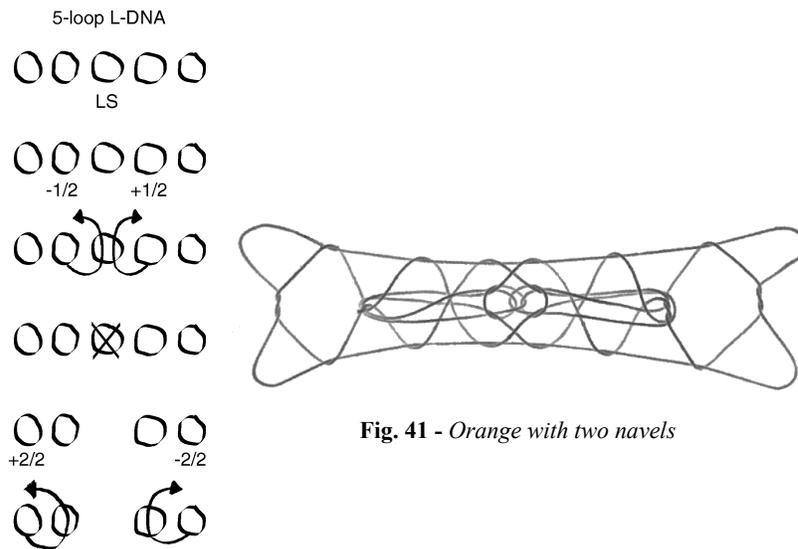


Fig. 41 - Orange with two navels

4-loop Bokola Out (4 replacing 3)

Fix bottom, Clean top

Two Diamond Ending (fig. 41)

Chart 8

Left Dominant Switch

- Transfer the left middle finger loop to the top of the right middle finger, inserting the right middle finger from below and from the near side; pass the left middle finger down through the right upper middle finger loop, then insert it, from below and from the near side, into the right lower middle finger loop; lift this loop off the right middle finger, drawing it up through the right upper middle finger loop as you return the left middle finger to its original position.

Two Diamonds Ending

- Thumb over all strings, picks up the far little finger string.

- Share the index loop with the thumb by lifting the near index string (segment close to the index) and placing it over the thumb.
- Navajo the thumb loops to create a “triangle” on the palm next to the thumb.
- Place index tip in triangle, release little finger loop, and rotate index away and up, catching the far string of the triangle (the original index loop slips off).
- Display with palms facing away, thumbs pointing towards the center and slightly down (fig. 41).

M. Sherman: Yes, a left dominant switch does alter the center. The orange now has two navels rather than one.

J. Murphy: And don't forget about iterating a subsequence as a means of adding complexity. For example, make Ornstein's First Figure up to the point where you push the wraps toward the center to lengthen the finger loops, then do all the moves again (fig. 42, chart 9). Improve the extension by using one of D'Antoni's two methods.

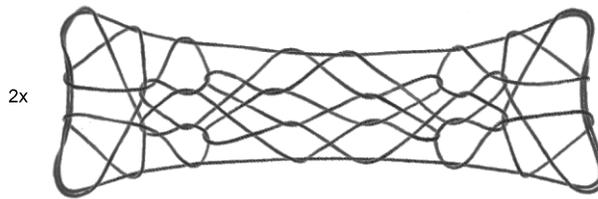
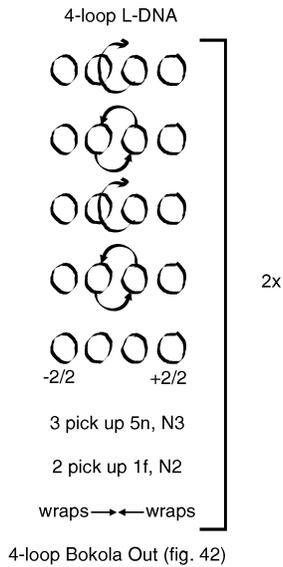


Fig. 42 - Ornstein's First Figure iterated

Chart 9

i love the intricate sides. Earlier today when my left hand felt stronger, i made a beautiful triple Ornstein's First Figure.

M. Sherman: I would love to see that!

J. Murphy: In conclusion, let me say that I've thought a lot about two subjects during my explorations, which should be addressed. First, someone should write an article speaking to the issue of different displays or ending maneuvers. *Inuit Out* (Murphy 2000:222-225), and now *Bokola Out* are only two potential methods for displaying the complexity one generates during the initial loop passages, loop rotations, and iterations of both. This has always been a holy grail of mine, to find the limits of expressibility of complexity within a string figure. Certainly there is a point where it becomes difficult, if not impossible, to extend a figure widely as a result of the center being too dense or the frame lines being too short.

Second, the properties of the string involved in a figure should also be addressed: length, material, how made, thickness, coefficient of sliding friction, stiffness, etc. All of these factors determine how much inner complexity can be displayed without the figure collapsing.

ACKNOWLEDGMENTS

Joseph D'Antoni, Mark Sherman, and James Murphy would like to thank Joe Ornstein for inspiring this exploration, and for making his unpublished *Funipulations* booklet available to us.

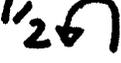
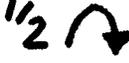
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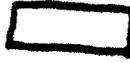
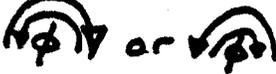
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APPENDIX

Key to Joe Ornstein's symbolic code for recording string figure methods

RIGHT HAND	H→
LEFT HAND	←H
THUMB	T
INDEX	X
MIDDLE	M
RING	R
LITTLE	L
PALM	P
WRIST	W
NEAR	n
FAR	f
PROXIMAL	p
DISTAL	d
LOOP	l
STRING	M
FINGER	φ

NAVAHO	N
REVERSE NAVAHO	N
RADIAL TWIST	
ULNAR TWIST	
1/2 RADIAL TWIST	1/2 
1/2 ULNAR TWIST	1/2 
PICK UP	π
DROP	Δ
TRANSFER	t_2
SHARE	\sqcup
PUSH UP	\uparrow
PUSH DOWN	\downarrow
LOOP UP THRU	\uparrow
LOOP DOWN THRU	\downarrow

OVER		or	
UNDER		or	
OPENING			
SUBROUTINE			
CAST OFF			
WHICH BECOMES			
CROSSED STRING			
SWAP		or	
OPENING A			
POSITION 1			
① STEP 2			
PICK UP DISTALLY			