

# Supplement: Of Loops, Braids, and String Figures: The Loopy Calculus of Cat's Cradle

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## String Figure Instructions

The literature on string figures uses a particular nomenclature for describing string figure constructions. We give the barest introduction to this nomenclature and encourage the reader to contact the International String Figure Association for more resources to learn string figures. They have many publications, documenting thousands of string figures, which are freely available to members through their website.

When the hands are relaxed, with palms facing each other and fingers pointing upwards, we say that the hands are in *normal position*. A segment of string around a finger is called a *loop*. The segment of a loop nearest the chest is the *near string* of the finger holding the loop. The opposite segment, farthest from the chest, is the *far string*. If a finger has two loops, the loop closest to the palm is the *lower loop* and the loop nearest the finger tip is the *upper loop*.

### *Opening 1 and Opening A*

Opening 1 and Opening A are two very common starting positions. To create Opening 1:

1. Put the loop around both little fingers. Separate your hands.
2. Put your thumbs into the loop from below, and draw the near little finger string back towards you.

This creates, on each hand, a loop running across the palms from the far side of the thumb to the near side of the little finger. To create Opening A:

1. Create Opening 1.
2. Put your right index finger underneath the string crossing your left palm. Pull your right hand back, drawing the former left palm loop back with it.
3. Repeat this on the right side: your left index finger passes to the right, and enters the right index loop. The left index pulls back the right palmar string from underneath.

This opening creates a loop on each thumb, index, and little finger. We note that the algorithm to produce Opening A uses the “sub-routine” for producing Opening 1. Even at this early stage of the workshop, we can see the algorithmic nature of string figures. Below, string figure constructions will call these sub-routines several times.

### ***Star***

It is helpful to make this figure with a shorter loop. We double-up our string to shorten it.

1. Place the doubled loop on your left middle finger and right pinky. Separate the hands with the palms facing each other.
2. Cross the right thumb from below into the loop. The thumb pulls back the near little finger strings. You now have a triangle around your right pinky, right thumb, and left middle finger.
3. Dip your left pinky into the string crossing the right palm from above. Bring your hands back to the starting position. This creates a twisted loop around your pinky.
4. Cross your left thumb from below into this pinky loop, close to the finger behind the twist. Pull the left thumb back.

You now have a five-point star on your left thumb, middle finger and pinky, and right thumb and pinky.

### ***Fish Spear***

This figure is sourced from Jayne [4, p. 32]. It was originally collected from Murray Island in the Torres Straits.

1. Opening 1.
2. Insert the right index from above behind the string crossing the left palm. Draw this string back towards the right, rotating it several times by twisting the right index. Straighten out the hands.
3. Using the left index, pick up the right palmar string from below. Make sure to pick it up between the strings of the right index loop, close to the hand where the loop is not twisted.
4. Release the loops on your right thumb and little finger.

This creates a spear or broom-like figure, with the handle on the right index finger and the points on the left thumb, index and little finger.

### ***Brokhos***

This string figure is the oldest recorded string figure construction. It was recorded by the Greek physician Heraklas circa 100 CE in a treatise on medical knots [3]. One can read a translation of the construction, with additional notes on its origin, in [2].

1. Opening A.
2. Both thumbs cross over the near index finger string, cross under the far index string, and draw this far string back.
3. You now have two loops on your thumbs: an upper thumb loop that you just pulled back from the index finger, and a lower thumb loop that was there initially. Both index fingers cross under the near string of the lower thumb loop from below and pull it back towards themselves.
4. Release all thumb loops. You now have two loops on your index fingers and one loop on your little fingers.

5. Thumbs dive into the lower index loop from above. Rotate the palms outwards slightly. The thumbs take up the far little finger string from below and pull it back through the lower index loops to rest on the thumbs.
6. Release the little finger loops. You now have two loops on the index fingers and one on the thumbs.
7. Using the thumb and index of your right hand, take the upper index loop off your left hand, twist it half a turn towards the little fingers and put it on the left little finger.
8. Symmetrically, using the thumb and index of your left hand, take the upper index loop off your right hand, twist it half a turn towards the little finger and put it on the right little finger. You now have a loop on your thumbs, indexes and little fingers.
9. Release the index loops and gently pull your hands apart.

### ***Koura (Crayfish)***

Koura is sourced from Andersen's *Maori String Figures* [1, p. 58].

1. Opening A.
2. Rotate the little finger loops a full twist towards the thumbs.
3. Thumbs pass over the index finger strings and under both little finger strings. Thumbs pull both little finger strings back.
4. Middle fingers cross over the index finger strings and pick up the far thumb string from below.
5. Release all thumb loops. You now have one loop on each of your little fingers, middle fingers and index fingers.

*The next move is tricky! It helps if your middle finger loops are a little higher up on the fingers than the index finger loops, and if you turn your palms slightly towards you as you execute the move.*

6. Thumbs enter index loops from below, travel up into the middle finger loops, and take up the near middle finger string from below. Thumbs pull this string back down through the index finger loops and return to normal position.
7. Release middle finger loops and tighten slack. You now have one loop on each of your thumbs, index fingers, and little fingers.
8. Release index finger loops and pull gently until the figure emerges.

### ***Brokhos Tacking***

Participants form pairs. In each pair, the partners choose who will be Partner 1 and Partner 2. Partner 1 should sit on the left of Partner 2.

1. Partner 1 creates Opening A.
2. The loops on Partner 1's right thumb, index and little finger are transferred to Partner 2's right thumb, index and little finger, respectively. For example, Partner 1 can gently release all of these loops and Partner 2 can pick them up, or loops can be transferred one by one.
3. Opening A is now suspended between Partner 1's left hand and Partner 2's right hand.

4. Using their free right hand to manipulate the loops, Partner 1 picks up the loop on their left thumb, moves it down through their index loop, and transfers it onto their middle finger.
5. Partner 2 mirrors this action: using their free left hand to manipulate the loops, Partner 2 transfers their right thumb loop down through their index loop and onto their middle finger.
6. Partner 1 passes their little finger loop under their middle finger loop, up through their index finger loop and onto their thumb. Partner 2 performs the same loop manipulation as Partner 1.
7. Both Partners transfer their middle finger loops to their little fingers.
8. Partner 1 picks up their thumb loop, rotates it a half-twist towards the little finger and places it back on the thumb. They do the same with the little finger loop, twisting in the same direction. Partner 2 mirrors both twists.
9. Simultaneously, Partners 1 and 2 release the loops on their index fingers and pull apart gently.

The resulting figure, suspended between the partners' thumbs and little fingers, will be the Brokhos.

### ***Koura Tacking***

1. As before, Partner 1 creates Opening A and transfers the three right-hand loops onto Partner 2's right hand.
2. Partner 1 picks up their little finger loop, rotates it a full twist (two half-twists) towards the thumbs and places it back on the little finger. Partner 2 performs the same loop manipulation as Partner 1.
3. Both partners transfer the little finger loops to the ring fingers.
4. Partner 1 picks up the thumb loop, passes it over the index loops, under the ring finger loops and places it on the little finger fingers. Partner 2 performs the same loop manipulation as Partner 1.
5. Partner 1 picks up the new little finger loop and passes it over the ring finger loops and onto the middle fingers. Partner 2 performs the same loop manipulation as Partner 1.
6. Partner 1 picks up the middle finger loop and passes it up through the index loops onto the thumbs. Partner 2 performs the same loop manipulation as Partner 1.
7. Both partners release the index loops and pull gently outwards....

The resulting figure, suspended between the partners' thumbs and ring fingers, will be Koura.

### **References**

- [1] J. C. Andersen. *Maori String Figures*. AMS Press, 1927.
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- [3] J. D'Antoni. "Plinthios Brokhos: the earliest account of a string figure construction." *Bull. Int. String Fig. Assoc.*, vol. 4, 1997, pp. 90–94.
- [4] C. F. Jayne. *String figures: a study of cat's-cradle in many lands*. C. Scribner's sons, 1906.