Craft Thinking

A relational approach to making and design

Brinck, Ingar

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The term *craft thinking* refers to a certain manner of proceeding within craft practice that is shared among and used by craft makers to increase the quality and efficiency of their work, and continuously is tested and refined within the craft communities. Craft thinking is intelligent, not intellectual, used to instruct and teach, to criticize a failing performance and infer the errors behind it, and to work out new ideas. Emerging within the relational dynamics of maker and material, it is a process that plays out against the background of expertise and specialized knowledge and permits dealing with novel circumstances in novel ways. Whereas design thinking is oriented towards satisfying the needs of the users, craft thinking takes its starting point in the potential of the material.

The concept of craft thinking, or holistic craft design as it has been called in craft science and related education (Rönkkö & Lepistö, 2016), underlines that craft practice includes planning and implementation in the form of mutually dependent perspectives that merge in a single variable process. It grants that the maker can control their own actions and the craft-making process and, furthermore, enjoys the freedom to experiment as a route to refinement (Slivka, 1961).

Putting collaboration with the material on centre stage, craft thinking relates thinking and intelligence to actions performed by hand. The notion of thinking with the material recurs in the literature on craft practice, with slightly different meanings. Curator and historian Glenn Adamson (2007) defined craft thinking as "a way of thinking through practices of all kinds" (p. 7). Sociologist Richard Sennett (2008) referred to the dialogue between craft maker and material that creates a coordination between mind and hand (p. 167).

Placed in the context of dialogue, craft thinking calls forth two distinct interpretations. The first one is in terms of verbal reasoning and criticism, used to scrutinize difficult and uncertain aspects of the craft maker's work while pausing the ongoing interaction, with criticism and assessment feeding back into the activity when it resumes. Thinking and doing play complementary roles. Famously developed by Schön (1983), this view has a prominent position in design and crafts, both in practice and research.

The second interpretation concerns nonverbal thinking. Grounded in sensorimotor processing, nonverbal forms of craft thinking draw on motor simulation, perceptual experience, feelings of emotion, and selective attention to monitor and control the craft-making process. Sometimes the material is addressed in the second person, as "you", within material agency. Craft makers regularly express the experience of having an embodied, emotional, and wordless dialogue with the material, while they are interacting with it (Brinck & Reddy, 2020).

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The chapter concerns craft thinking in the second sense, as it occurs within the craft-making process when the maker is engaged in manipulating the material using the hands and body. The aim is to explain how nonverbal craft thinking enables operating critically and coping with problems such as uncertainty, insufficient information, and insufficient quality within the craft-making process. I identify three cases of nonverbal craft thinking and examine them one by one, focusing on how each fulfils its function and what skills and cognitive processes they rely on. Referring to research in psychology, philosophy, and cognitive science and to practice-led research, I will model the explanatory framework on dynamic systems theory (Brinck, 2007), focusing on the relational dynamics between maker and material.

Before embarking on the investigation of the cases, I will present two perspectives on craft thinking, one that emphasizes its dialogic nature, and another that considers the constraints imposed on craft thinking by its developmental trajectory that restricts its use.

The relational dynamics between maker and material

An experienced potter will throw a bowl within minutes, while weaving a rug by hand on the loom can take several months. Whatever the material, technique, and length, the craft-making process exhibits a similar progressive development driven by the relational dynamics between maker and material. To illustrate the intricacy and fundamental reciprocity of the craft-making process, the next paragraph describes the characteristic elements of wheel throwing.

Before the clay is placed on the wheel, it needs homogenizing. The potter wedges or kneads the clay mound by repeatedly placing their hands with the palms down on top of it and moving them downwards while applying pressure to smooth it out. Throwing begins by centring the lump of clay on the wheel, moving it into a symmetrical position on the wheel head by a series of raising and lowering movements. The mound is raised into a tall, narrow cone (i.e., coned up) by placing the hands opposite one another, pressing from the bottom moving up towards the top, hard enough to make the centre of the mound move with its surface and avoid a hollow on top. Then lowering begins. Exploiting the rotating force of the wheel, the cone is tilted in the wheel direction, pushed down, and made to disperse. The procedure is repeated, each time with a smoother, more compact, and on centre mound.

The last raising of the mound initiates forming. To make a bowl shape, the potter puts their cupped hands around the clay and forms a ball. Beginning the interior of the bowl, fingers or thumbs are slowly pushed down into the centre of the ball. The wall is pulled apart, leaving a base that is compressed to a bottom with lateral sweeping of the fingers to prevent later cracking. Finally, one hand is placed on the interior and the other on the exterior, synchronously pulling up (i.e., raising) and thinning the wall, with the fingertips of both hands reaching the top together.

The spinning wheel puts potter and material in contact, transforming one kind of energy to another (Ingold, 2013, p. 102). Potter and university teacher Kenneth Beittel (1989) underlined the importance of bringing body, wheel, and clay into harmony from the beginning, since error in the relational dynamics cannot be undone. As minor behaviour changes may cause overall transitions, mistakes can be costly. The first raising is the most difficult, because the mound "has memories of wedging, clapping, and off-centredness within it" (Beittel, 1989, p. 51). You need to make the inert mound move without forcing it, or the clay's memories of the past will not be replaced by the new

manipulation. M. C. Richards (1989), potter, poet, and teacher, explained that if you move the clay before it is physically ready, it will regain its previous shape (p. 35).

Overcoming these obstacles involves striking a balance between body and clay, using the speed and force of the wheel to transport the mound, and then bring oneself to move with it. Organized by timing and rhythm, the movements of maker and material are mutually constraining. Synchronizing to the movements of the clay permits the emergence of patterned behaviour that stabilizes the dynamics. Built around the notions of reciprocity and material agency, craft making – and craft thinking – is fundamentally collaborative.

Considered instead within the perspective of motor learning, craft making and so craft thinking are determined by sensory and motor processes outside the reach of conscious awareness. New skills develop by the acquisition of new movement patterns relative to task and context (Mirdamadi & Block, 2020). However, lacking the resources that later will guide motor learning and permit understanding the teacher's instructions, the novice is unable to perform the movements involved in learning the new skill.

As it happens, skill development begins by random explorative behaviour performed relative to the physical goal (Mirdamadi & Block, 2020). On first encounter, the clay on the spinning wheel will trigger chance behaviour in the novice. Persistent training to gain control of the movements soon will lead to the growth of muscle strength (Sternad, 2018). Stronger muscles permit training other movements that increase speed and flexibility of the fingers.

Eventually the novice will be ready to start practising the very actions that define the craft, such as raising and lowering movements of throwing. Now the sensorimotor contingencies that link sensory input to motor output within craft making start to build. In time, they will form a meaningful pattern that supports the self-organization of behaviour and perceptual experience and enables perceptually guided action, that is, cognitive, or intelligent behaviour.

The sensorimotor contingencies that support the on-line emergence of craft thinking within the craft-making process, simultaneously limit its scope. By grounding craft thinking in the situational context where it once begun to develop, they limit generalization to other domains. Hence, the learning perspective reveals that an individual's capacity for craft thinking is constrained by the situation in which it first emerged. The *contextual determinants* of craft thinking do not necessarily show up in the phenomenology of making but may remain hidden to the craft maker. This raises a host of questions, concerning experiential embodied knowledge such as: What are the consequences of sensory and perceptual experience that constrains behaviour, but does not show up in phenomenology, for experiential embodied knowledge, for instance, for its epistemic status?

To provide another example, in craft practices that favour manual action, craft thinking originates in the joint processing of touch, which depends on feedback from the environment, and proprioception and kinesthesis, which rely on feedback in the body. This means that the awareness of force, effort, fluency, and precision of movement, the experience of motion (i.e., movement kinematics), and haptic and tactile sensing are basic to craft thinking. However, visual experience often appears primary within the phenomenology of making. What does this mean for how we understand the role of sensory and perceptual experience in the craft-making process and within craft thinking? To stress, the two perspectives are not as such in conflict, although they may work at cross-purposes. It seems important to recognize that the practice of craft thinking is influenced by sensorimotor processing in ways we do not always understand, and this concerns the choices and decisions made within the craft-making process too.

The remainder of the chapter examines the notion of nonverbal craft thinking in detail, examining three cases related to epistemic action, thinking-in-action, and withness-thinking.

Epistemic action

Within the craft-making process, most actions occur relative to the material. The hands are not only used to feel, grasp, and create but also play a cognitive role in managing the pragmatics of making. Making shows a mix of pragmatic and epistemic, meaningful physical actions (Kirsh & Maglio, 1994, pp. 13–15). *Pragmatic* (tangible, applied) actions are performed to achieve a task or reach a goal such a forming a bowl from clay. *Epistemic* (interrogative, probing, explicatory) actions are performed to improve the conditions for pragmatic action by revealing information and facilitating cognition, such as re-organizing the workspace, re-positioning the clay on the board of the wheel, or visually checking the state of the clay and comparing with how it feels to the hands (Kirsh, 1995; Shercliff, 2019). The arrangement of tools and materials in physical space indicates a temporal order and mode of procedure. Reducing memory load or simplifying search and categorization will increase efficiency and disclose information.

Epistemic actions can change the course of events and the outcome of making in one single move. Consequently, they play an indispensable role for the quality and efficiency of performance. Often performed absentmindedly, they stay one step ahead of conscious deliberation and verbal reflection that are notoriously slow. In verbal form, epistemic action would entail significant cognitive and processing costs.

Research about craft practice tends to focus on the pragmatic actions that shape the material, while epistemic actions pass under the radar, and have gone unnoticed (Penny & Fisher, 2021). The tendency to epistemic action is strong enough to permit putting them on hold, without negatively influencing performance. When manual tools and handheld powered machine tools are used, one might expect the ensuing lack of contact with the material to hamper epistemic action, which draws on sensory contact with the material. However, the lack of tactile and haptic information to monitor and control the motorized work process can be compensated for during the breaks, when the tools are resting, and does not necessarily change anything of importance to the making process. What matters is that the hands can draw the right conclusions from the information, predict the adequate actions, and determine how to go on, all of which depends on learning and demands paying attention to the present.

The following situation, based on my first-hand experience of woodwork and observations of carpenters at work, illustrates the function of epistemic action, and how epistemic actions occur spontaneously in a tide of passing tests and nonverbal analyses. The carpenter is shaping and cutting wood with his chisel – shaving rough surfaces, chopping out corners, making the joints – while regularly taking brief breaks, letting the work rest. The focus is on the events that transpire during the breaks, when the carpenter's hands intervene to check the progress of the process and the quality of the work, as it seems, without the carpenter's paying attention.

The resting hand holds the tool, whilst the other hand takes complementary action, exploring the worksite efficiently and flexibly. Clearing the surface from the chips of wood left behind by the chisel, the hand is moving back and forth, engaging the fingertips to feel the marks that the chisel left on the surface. Then the index finger traces the curves of the lines caused by etching. Once finished tracing the lines, the right arm is stretched

out towards a mortise, the hand reaching into the hole with the finger to check its depth and the angle of the corners, then feeling the texture of the walls. When the carpenter resumes his work again, the results of this explorative behaviour will feed directly into the enduring chain of pragmatic action.

Thinking-in-action

Epistemic action constitutes a spatiotemporally dispersed form of craft thinking. Action sequences underlie another type of craft thinking that to its form parallels trains of thought but fundamentally is a practical ability. Philosopher Gilbert Ryle's (1949, pp. 40–48, pp. 137–138) notion of intelligent skill, or *thinking-in-acting*, is functionally independent of language use and logical reasoning, yet captures the (strictly) intelligent facets of craft thinking. Craft making involves using intelligence in real, variable, and unpredictable situations, determined by maker, material, tools, technique, and task together. Coping with such situational uncertainty requires flexibility and thoughtful improvisation – produced on the spur-of-the-moment by applying lessons already learnt to unfamiliar conditions (Ryle, 1976, p. 77). Ryle convincingly argues that paying heed, that is, acting carefully and vigilantly, is necessary for coping.

In practice, paying heed means thinking what you are doing while you are doing it, and minding how you do it (Ryle, 1949, p. 45; 1976, p. 71). It presupposes *situational awareness* that is established by, first, selective (perceptual) attention to the current situation that permits assessing its difficulty, and second, self-assessment that makes your degree of skill explicit. Research about expertise in sports psychology and related areas corroborate the importance of situational awareness. Summarizing their own and others work on expertise during the last two decades, Toner et al. (2023) concluded that body awareness, active attention to one's own movements and correlated contextual changes, and skill-focused attention to performance are vital for maintaining competence when performing in difficult or uncertain situations characterized by insufficient information.

Balancing perceived difficulty and personal skill, situational awareness constitutes the starting point for paying heed by the online generation, evaluation, and selection of criteria for action. These criteria help you predict the outcome of action and determine whether an action matches your skills. The use of criteria constitutes the backbone of thinking-in-acting and can guide the craft-making process moment-by-moment. It provides a strategy for breaking down complexity to simple steps and making thinking tangible. If you go wrong, knowing which criteria failed you will help selecting others.

Thinking-in-acting serves as a guarantee against slip-ups and carelessness, manifest in the ability of seeing something through (Ryle, 1949). The methodical use of criteria that align maker and material with the situation entails proceeding in small overlapping steps and affords the maker continuous access to the unfolding stream of events. Nothing is left to chance although the activity in its entirety is improvisational. The procedure is rigorous (Niedderer & Townsend, 2014). It shows that sequential cohesion does not allow for exceptions and, given situational awareness, keeps to the highest standards.

To illustrate his theory, Ryle (1949) described how an experienced mountaineer manages to walk over ice-covered rocks in strong wind in the dark (p. 42). The mountaineer does not move his limbs by habit but walks with skill and (perceptual) judgement. He is attentive to each step he takes, and economizes in effort, while experimenting. Thinking what he is doing whilst doing it, the mountaineer is systematically yet spontaneously choosing his movements and actions while adapting to the capricious situation.

Concomitantly walking, and teaching himself how to walk, the mountaineer shows integrity and competence. Because every operation performed is a lesson to perform better, his skills are continuously improving.

Ryle's (1949) thinking-in-acting and Schön's (1983) reflection-in-action display a spurious surface similarity. Ryle's notion does not depend on (nor exclude) verbal thinking or logical reasoning. Thinking-in-acting involves methodically engaging with the physical situation while probing it for information that will help achieving the ongoing task. Intelligent skill is integrated with the situational context. In Schön's case, the physical context is not part of the actual thinking. It functions as a backdrop to verbal reflection about the present and what to do next, involving criticism and re-description. Schön (1983) demonstrated that practitioners can have a reflective conversation with the design situation, while Ryle argued that practitioners can be skilfully engaged with the material in an intelligent yet nonverbal manner. They investigated different but compatible behaviour.

An ethnographic study of how the master potter instructs his student based in visual data, discloses the profoundly embodied nature of craft making (Gowlland, 2015). The student's growing understanding of his task materializes in visible action while he is interacting with the clay (for a glass context, see also O'Connor, 2005). In contrast to correctly executed movement, skilful behaviour engages the entire body in the developing process. Within the action sequence, each movement has its proper place, and knowledgeable movements are both skilful and graceful – skill and grace re-enforce each other within the process. The master potter demonstrates that craft thinking too is multimodal and multidimensional, distributed over hands and tools, across the senses and the body, and manifest in the proactive and anticipatory movements of gaze, feet, torso, hands, and hips, joined in one continuous, dynamic probing motion. Fluid, automatic transitions that connect experience, motion, and emotion, organize the behaviour holistically, signalling competence, expertise, and hindsight. *Fluidity* across movements results in less effort being spent while efficiency increases. This explains why the novice regularly interrupts the work out of exhaustion, while the master carries on without effort.

Finally, emotion has strong significance for thinking-in-acting. Groth (2015) argued that the body generates multimodal embodied experiential knowledge about the material that is used to assess its quality and the purposes for which it might be employed. Thus, holding the clay in the hands will result in the complex haptic experience of temperature, density, plasticity, humidity, and resistance. Groth ventured that the way something feels to the perceiver seems to affect the way the perceiver feels, suggesting an interrelation between tactile experience (i.e., having skin contact with the material) and feelings of emotion.

The *cognitive role of emotion* relates to the emotional expression of materials (Niedderer & Townsend, 2014) and the close tie between motion and emotion in the perception-action loop (Brinck, 2018; Sheets-Johnstone, 1999). Motion constitutes the "how" of bodily movement, manifest in qualitatively felt, kinetic flow blended with affect that resides in the margins of awareness (Sheets-Johnstone, 2012). The potter can use kinetic flow to shape performance, alternatingly matching, complementing, counterbalancing, countering, compensating, and reinforcing the changes in the clay.

Research about motor skill and expertise in psychology verify the critical role of perceptual attention for the monitoring and control of performance (Brinck & Liljenfors, 2013). Metacognitive experience is prominent in craft making. Groth et al. (2015) described how the potter monitors the progress of throwing through the fingertips in continual contact with the clay, noticing that the process is guided by emotion (p. 76).

They found that feelings of emotion related to confidence and stress contribute to risk assessment, decision-making, and problem-solving. Metacognitive feelings reflect the maker's understanding of the creative process, as illustrated by textile artist Emma Shercliff (2019), who writes: "I know when it feels right. Repeated practice and correction over time has habitualized this knowledge into my hands" (p. 74). In short, in monitoring-based control, feedback concerns the outcome, such as feelings-of-knowing; in control-based monitoring, feedback concerns the process itself, such as fluency and the effort required to perform a certain task (Brinck & Liljenfors, 2013).

Withness-thinking

Based on high speed and accuracy of movement (Fuster, 2004), the tight timing of the master of craft readily will cause maker and material to couple. Coupling is sudden and transformative, beyond the craft maker's control. When two cognitive systems reorganize into a configurational whole, it results in the compression of similar behaviour. Maker and material temporarily will function as a single agent with increased capacities for action that provisionally decrease the risk of error in the relational dynamics. Coupling will cause synergies, or unforeseen combined effects, such as the emergence of novel shared behaviour and affordances to act.

Practitioners sometimes refer to integration instead of coupling, suggesting it would bring great benefits to craft making. Architect Juhani Pallasmaa (2009) maintained that designers and craft makers internalize materiality in a manner that transforms the makers themselves into material and permits feeling and experiencing with materials. Sennett (2013) maintained that integrating with the material allows for predicting its imminent movements and shape, and the ensuing interaction. Textile artist and researcher Nithikul Nimkulrat expressed similar views in a study that examines whether manipulating the material will influence its expressive qualities (Nimkulrat, 2010; 2012).

Nimkulrat (2010) argued that letting the material take the lead in the creative process will permit understanding the making process from within the practice. Specifically, she claimed that manipulating the material can establish a rhythmic interplay between bodily and thinking practices. She described how she would decide what rhythm the hands should keep in relation to the knotting structure – how hard to pull the strings and how fast to perform the cycle of manipulations. Then focusing on maintaining the "accurate force and speed of manipulating the material" (p. 77), the motion of the making hand allowed her to anticipate how the making process would unfold. Sharing the rhythm with the material would permit transferring the material's expressive properties to the emerging artefact, which means the material actively influenced the generation of form, content, and context of the work (p. 65).

Coupling has a participatory effect on the maker that boosts motor skill (Tholander & Johansson, 2010) and generates feelings of trust in the material and connectedness. Experiencing such changes in a material, as directed at me, and having a personal value, springing from the precise actions and movements I just performed, makes the details of the interaction strongly meaningful and facilitates re-shaping and fine-tuning performance.

Similarly, the motion and efficiency of movement reflect a master potter's engagement with the moving clay. When "changes in the position, posture, and movements of the body are co-constituted with the changes in the form of the clay" (Malafouris & Koukouti, 2017, p. 199), the potter is experiencing *with* clay (Brinck & Reddy, 2020, p. 42).

Consequently, coupling affords *withness-thinking* when the maker purposively acts with the material instead of towards it, and they are moving in the same direction. The qualitative experience of simultaneously feeling and seeing the clay's movements will move the potter towards new possibilities for action. Joint processing of touch and kinesthesis entails that the sensation of touch is determined by movement on the scale of the body, which means it can connect the potter to other agents experientially, be it clay or human, as embodied selves. By pressing the hands against the clay on the wheel and moving with it, the potter experiences sharing its rhythm.

In physical contact with the clay, the experience of moving together prompts the potter to engage emotionally. Emotional engagement constitutes the phenomenological side of coupling (Brinck & Reddy, 2020). Driven by curiosity and interest, it turns an encounter into an exchange that plays out in the negotiation of feelings with the clay. Emotional engagement has strong motivational force. Accordingly, what makers' experience in engaging with the material is determined not merely by what they do and know how to do as in thinking-in-acting, but *what they are ready* to do (Noë, 2004, pp. 1–2).

The potter takes possession of the creative process by emulating the clay's movements and orientation, and continuously re-distributes body weight, orientation, and attention in correspondence with the clay. E*x*periencing with the material leads forward beyond individual limitations and abilities (Brinck & Reddy, 2020). Distinct from turn-taking and dominant-subordinate relations, emotional engagement puts the opportunities and needs for the material first and places the potter in the listener's position. The sensitive potter is thinking with the clay, gaining direct access to the agency of the material, which permits knowing its state of transition, and predicting how it will change.

Examining the maker-material dynamics in felt making, Aktaş (2019) noticed the emergence of a similar relational dynamics as in witness-thinking. A certain kind of movement and manner of touching the material leads to the transformation of behaviour and the emergence of complementary patterns of practice. Attaching equal importance to sensing and acting on the felt results in the continuous improvement of skill and increased complexity. Aktaş concluded that attentive listening is critical for the development of a resilient relational dynamics between maker and material and for establishing a successful practice. This conclusion should apply to all the crafts.

Concluding remarks

The analyses of epistemic action, thinking-in-acting, and witness-thinking showed that each has its own modus operandi that permit them to perform both the critical and restorative tasks of craft thinking, and moreover, they draw on separate cognitive resources. Generally, the examination reveals that the material is not conceived a means for craft thinking but rather is a partner that can assist the craft maker in their work. This view is especially evident in withness-thinking where the material is explicitly addressed as co-agent.

The collaborative attitude towards the material can be traced back to the moment when the craft student first learns to synchronize their movements with the material and share the rhythm. Moving together with the material and literally sharing the orientation apparently constitutes a precondition for producing craft of high quality. The opposite would mean working against the tendency of the material. This will not merely increase the difficulty and effort of craft making, but destroy the inherent potential of the material, and so may be perceived as unethical. Consequently, the very possibility of craft thinking

as a viable manner of proceeding presupposes that the maker strives to align with the material, showing respect and care for it.

Certain craft makers show a strong motivation to realize the potential of the material and satisfy its needs, for instance, preferring a tool that is more arduous to work with but minimizes the impact on the material. Phrasing this behaviour in terms of professional pride might be useful to clarify the difference between craft thinking and design thinking, as designers conceive of it today.

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