Review Article

# **Roles of Handedness and Hemispheric Lateralization:** Implications for Rehabilitation of the Central and Peripheral Nervous Systems: A Rapid Review

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**Importance:** Handedness and motor asymmetry are important features of occupational performance. With an increased understanding of the basic neural mechanisms surrounding handedness, clinicians will be better able to implement targeted, evidence-based neurorehabilitation interventions to promote functional independence.

**Objective:** To review the basic neural mechanisms behind handedness and their implications for central and peripheral nervous system injury.

**Data Sources:** Relevant published literature obtained via MEDLINE.

**Findings:** Handedness, along with performance asymmetries observed between the dominant and nondominant hands, may be due to hemispheric specializations for motor control. These specializations contribute to predictable motor control deficits that are dependent on which hemisphere or limb has been affected. Clinical practice recommendations for occupational therapists and other rehabilitation specialists are presented.

**Conclusions and Relevance:** It is vital that occupational therapists and other rehabilitation specialists consider handedness and hemispheric lateralization during evaluation and treatment. With an increased understanding of the basic neural mechanisms surrounding handedness, clinicians will be better able to implement targeted, evidence-based neurorehabilitation interventions to promote functional independence.

**Plain-Language Summary:** The goal of this narrative review is to increase clinicians' understanding of the basic neural mechanisms related to handedness (the tendency to select one hand over the other for specific tasks) and their implications for central and peripheral nervous system injury and rehabilitation. An enhanced understanding of these mechanisms may allow clinicians to better tailor neurorehabilitation interventions to address motor deficits and promote functional independence.

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Occupational therapists are experts in promoting occupational performance and functional independence. One aspect of the ability to engage in meaningful occupations is the very observable human characteristic of *handedness,* or the tendency to select one hand over the other for specific tasks or features of a task. Approximately 90% of the population is right-handed, with the remaining 10% often categorized as left- or mixed-handed, and this ratio has seemingly remained consistent over several thousand years (Coren & Porac, 1977; Papadatou-Pastou et al., 2020). This overwhelming bias toward right-handedness places humans at the extreme end of the distribution of handedness biases among primates. Our nearest evolutionary neighbors have weaker population biases, although these vary by species and are highly task specific (Lonsdorf & Hopkins, 2005; Zhao et al., 2012). For example, chimpanzees and bonobos, our closest cousins, have a 50% to 70% right-hand preference (i.e., 0%–20% right-hand bias), depending on the task (Hopkins, 2006; Hopkins et al., 2011; Lonsdorf & Hopkins, 2005). Other nonhuman primates, such as gorillas and orangutans, have weaker population biases but have been shown to develop individual biases (Caspar et al., 2022; Hopkins, 2006). Individual primates may also exhibit *ambiguous* (i.e., unclear) handedness (Chapelain et al., 2011), which is rare in humans (Cochet & Vauclair, 2012). Because of this specificity to humans, and potentially other great apes, some scholars have proposed that handedness evolved alongside the development of tool use and increased reliance on social learning (Uomini & Ruck, 2018). Thus, handedness and behavioral asymmetries observed between the hands are important features to consider when understanding occupational performance, and poorly established or disrupted features of lateralization may be detrimental for participation in meaningful activities. Occupational therapists and other rehabilitation specialists must take into account handedness during evaluation, intervention planning, and outcome measurement at all levels of service delivery.

The overarching themes that guided the development of this review article are the basic neural mechanisms behind handedness and their implications for central and peripheral nervous system injury. We discuss how handedness, along with performance asymmetries observed between the dominant and nondominant hands, may be due to hemispheric specializations for motor control. We review the literature surrounding how these specializations contribute to predictable motor control deficits after central and peripheral nervous system damage that are dependent on which hemisphere or limb has been affected. Last, we provide recommendations for clinical practice, including accounting for premorbid handedness during evaluation and considering the specific roles of the dominant and nondominant hands during occupational therapy interventions.

## Relationship Between Hand Preference and Hand Performance

In this review, we operationally define *handedness* as hand preference, but the lay term *handedness* can refer to three separate constructs: (1) hand preferences for action, sometimes called *hand choices* or *hand usage;* (2) self-reported hand dominance; and (3) performance asymmetries between the two hands. These three concepts are not interchangeable. Hand preference depends, in part, on performance asymmetries between the hands (Coelho et al., 2013), but task-specific demands may also increase or decrease use of the self-reported dominant hand (Gonzalez et al., 2006; Stone et al., 2013). Task-specific training can improve performance of the nondominant hand (Kami et al., 1995; Philip & Frey, 2016; Solum et al., 2020; Wischnewski et al., 2016), but changes in performance have unreliable effects on self-reported hand dominance (Teixeira & Teixeira, 2007) and minimal effects on hand preference (Dexheimer et al., 2022; Philip et al., 2022; Sandve et al., 2019). Self-reported hand dominance surveys, such as the Edinburgh Handedness Inventory (Oldfield, 1971), have been questioned with regard to the effectiveness of determining hand preference at specific tasks (Flindall & Gonzalez, 2019). Overall, little data exist to clarify the relative impact of these three factors on patient life, because of inadequate assessment.

Many surveys and assessments have been designed to overlook activities that depend on lateralized behavioral specializations. For example, the Disabilities of the Arm, Shoulder, and Hand (DASH) survey has 2 of 30 questions that depend on handedness (Philip et al., 2020), and both of those questions are omitted from the QuickDASH (Beaton et al., 2005). Moreover, common upper extremity assessments, such as the Fugl-Meyer Assessment of Motor Recovery After Stroke (Fugl-Meyer, 1980), Action Research Arm Test (Lyle, 1981), and Box and Block Test (Mathiowetz et al., 1985), do not measure or isolate the specific fine motor control skills that depend heavily on dominant hand specializations for movement control (Connell & Tyson, 2012; Murphy et al., 2015). To identify the effects of handedness on patient life and activities, therapists must take care to recognize which construct they wish to measure: hand preference, self-reported hand dominance, or performance.

## Development of Handedness in Pediatric Populations

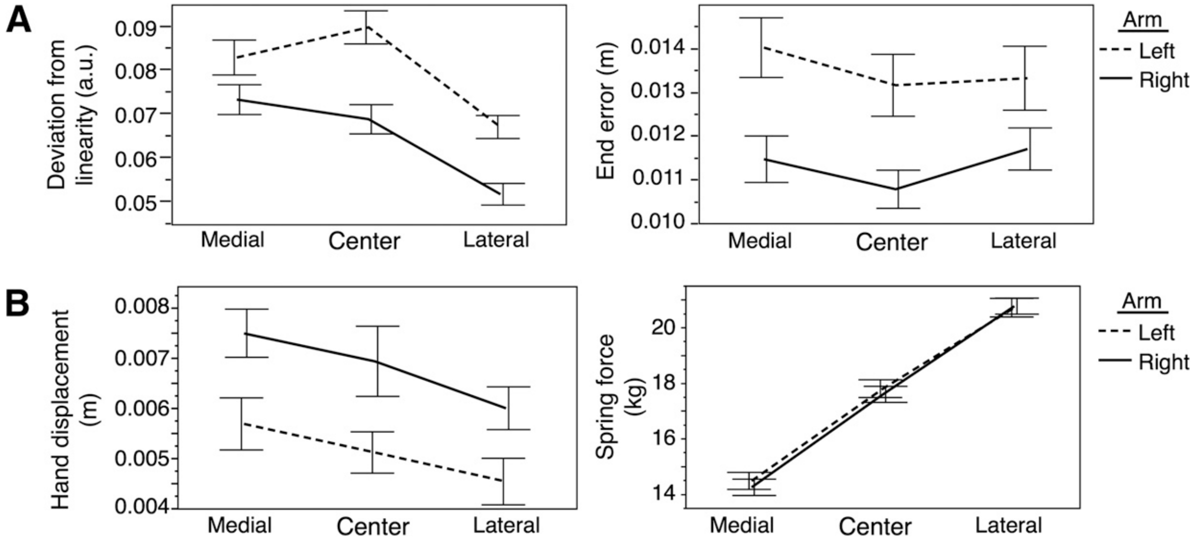
The underlying developmental mechanisms that determine a person's handedness remain unclear, but this is likely a result of both genetic and environmental factors (McManus et al., 1988; Nelson et al., 2013; Papadatou-Pastou et al., 2020). Infants as early as age 6 mo may exhibit consistent hand preferences when reaching for objects (Nelson & Gonzalez, 2020); however, the extent to which these preferences can predict the person's adult handedness remains controversial. Some studies have proposed that handedness can be detected as early as in utero from asymmetries in palmar grasp reflexes (Tan, 1994), whereas others have shown that it can be predicted in infants as early as age 11 mo on the basis of patterns of hand preference for object acquisition (Campbell et al., 2015). Other longitudinal studies have suggested that handedness does not become relatively stable until around age 24 mo, because infants frequently change hand preferences across observation timepoints (Fagard & Lockman, 2005). Some research has even suggested that stable handedness is not solidified until as late as ages 4 to 6 yr (McManus et al., 1988). Thus, the point at which handedness becomes stable remains unclear. We should note that methods of quantifying handedness have varied between studies in children, and may, at least in part, be responsible for the variations in reporting the emergence of consistent handedness. However, previous studies have demonstrated a correlation between poorly established hand preference and an increased risk of a variety of neurological conditions (Rodriguez et al., 2010; Rodriguez & Waldenström, 2008; Somers et al., 2009). Higher rates of mixed-handedness, compared with the general population, have been observed in people with dyslexia (Brandler & Paracchini, 2014), cerebral palsy (Lin et al., 2012), developmental coordination disorder (Goez & Zelnik, 2008), and autism (Cornish & McManus, 1996; Escalante-Mead et al., 2003).

## Hemispheric Specializations for Motor Control

In adults, handedness and motor asymmetry are important features of nearly all aspects of occupational performance. The dominant hemisphere and its corresponding hand (left hemisphere for right-hand–dominant people) is commonly identified as superior, with many often assuming that the dominant hand will perform better at all aspects of all upper extremity tasks (Annett et al., 1979; Taylor & Heilman, 1980; Ziemann & Hallett, 2001). However, kinematic comparisons of dominant and nondominant arm performance have challenged this assumption. For example, in a bimanual task mimicking how the hands work together in complementary roles, Woytowicz et al. (2018) asked participants to complete a stabilizing and reaching task in a virtual reality environment. To mimic how the hands perform coordinated actions during bimanual activities of daily living (ADLs), each participant's hands were connected by a spring, producing displacement-dependent forces between the hands. One hand was required to stabilize over a target location while the other hand made reaching movements to target locations that appeared rapidly within the virtual reality environment. Participants were more effective at stabilization when using their nondominant hand for this aspect of the task (i.e., they showed less hand deviation from the center of the target) compared with those who were instructed to stabilize with their dominant hand, as shown in Figure 1, Panel B. Conversely, those who used their dominant hand to reach to the target locations demonstrated smoother reach trajectories and more accurate reaching compared with those who used their nondominant hand (Figure 1, Panel A). Most important, the findings indicated that arm compliance was greater when the stabilizing arm was the dominant one, as compared with the nondominant one, indicating that the nondominant arm showed better modulation of limb mechanical impedance for stabilizing against the changing spring load. These findings suggest that the underlying control mechanisms for the dominant and nondominant hands are distinctly different and seemingly complementary, resulting in the observed specialization of the nondominant hand for stabilizing and countering against unwanted forces (e.g., the forces imposed by the spring) and the dominant hand for smooth and accurate reach trajectories.

Goble et al. (2006) investigated lateralized specializations in the use of proprioceptive feedback by comparing proprioceptive matching abilities between the dominant and nondominant arms. Participants were passively moved into either 20° or 40° elbow flexion, held in that position for 2 s, then returned to a full elbow extension starting point. They were then asked to match the elbow flexion angle with their

**Figure 1. Performance asymmetries between the dominant and nondominant hands during a bimanual reaching and stabilizing task.**



*Note.* Panel A: Deviations from linearity (left) and end errors (right) for the slicing portion of the task. Panel B: Hand displacement (left) and spring forces (right) for the stabilizing portion of the task. a.u. = arbitrary units. From "Handedness Results From Complementary Hemispheric Dominance, Not Global Hemispheric Dominance: Evidence From Mechanically Coupled Bilateral Movements," by E. J. Woytowicz, K. P. Westlake, J. Whitall, and R. L. Sainburg, L., 2018, *Journal of Neurophysiology, 102*(2). https://doi.org/10.1152/jn.00878.2017. Copyright © 2018 by The American Physiological Society. Reprinted with permission.

contralateral arm. The researchers showed that, for both conditions (20° and 40° elbow flexion), the participant's nondominant arm re-created the position more accurately, with an average of 40% less matching error. They concluded that a nondominant-arm advantage in this task may reflect a specialization for using proprioceptive feedback to maintain static positioning, such as stabilization of an object during a bimanual ADL.

Dexheimer and Sainburg (2021) compared the relationship between reaching speed and accuracy between the dominant and nondominant hands. Participants were instructed to reach to different target locations as they appeared in a two-dimensional virtual reality workspace, emphasizing both speed and accuracy during the reach. Half of the participants performed this task with visual feedback of their hand location, and the other half could not see the location of their hand within the virtual environment. The authors found that, for the participants who could not see their hand location during the reaching task, those using their nondominant hand reached with higher rates of speed-normalized accuracy, but only during the early stages of the task (when they had limited experience reaching to each target location). For the participants who received visual feedback of their hand location, those using their dominant hand reached with higher speed-normalized accuracy throughout the entire duration of the reaching task. Thus, the authors proposed that the mechanisms underlying dominant hand control may be more reliant on access to visual feedback and task experience compared with the nondominant hand.

Taken together, the studies just described suggest a bihemispheric model of motor control, that is, (1) the hands appear to use different control strategies, and (2) these strategies result in different specializations of the dominant and nondominant hands for specific aspects of movement. The dominant hemisphere may be specialized for aspects of movement that prioritize smoother trajectories and increased energetic efficiency, such as writing and throwing (Sainburg, 2002; Yadav & Sainburg, 2014). Conversely, the nondominant hemisphere may be specialized for aspects of movement that stabilize against unpredictable forces arising from the body and the environment (Dexheimer & Sainburg, 2021; Przybyla et al., 2013; Yadav & Sainburg, 2014). In the context of ADLs and instrumental activities of daily living (IADLs), these specializations may be observed during a variety of bimanual tasks. For example, the act of opening a jar requires a stabilizing hand (the nondominant) along with a hand (the dominant) applying the direction-specific torque on the jar top to twist it open. In another example, using scissors to cut paper requires stabilization of the piece of paper with the nondominant hand while precisely manipulating the scissors with the dominant hand. Although bimanual tasks such as these are a ubiquitous feature of daily life, the differing contributions of both hands and hemispheres are often overlooked.

## Applications to Central Nervous System Damage

Because each brain hemisphere is specialized for different features of motor control, unilateral lesions—such as those resulting from a stroke—may produce motor deficits that differ depending on the affected hemisphere (left vs. right) and are consistent with that hemisphere's proposed specialization. Moderate to severe unilateral sensorimotor stroke due to middle cerebral artery blockage often results in contralesional (i.e., opposite-side) motor deficits, and research supports the hypothesis that the hemisphere affected (left vs. right), along with the specific lesion location, directly affects the severity and presentation of these contralateral deficits (Maenza et al., 2020; Mani et al., 2013; Mutha et al., 2011a, 2011b; Schaefer et al., 2007, 2009a, 2009b). In a study quantifying specific aspects of these movement deficits, Mani et al. (2013) showed that stroke patients with mild to moderate hemiparesis after left-hemisphere stroke (LHS) demonstrated disruptions in smooth movement trajectories for the contralesional right arm compared with control participants. Conversely, patients with similar levels of hemiparesis after right-hemisphere stroke (RHS) demonstrated deficits in effective stabilization of the contralesional left arm during the end stages of movement (Mani et al., 2013). Taken together, these studies support the hypothesis that motor deficits subsequent to unilateral stroke are dependent on the hemisphere affected.

Ipsilesional (i.e., same-side) movement deficits have previously been attributed to one-handedness or slower performance as a result of poststroke cognitive deficits. In rehabilitation, this is often referred to as the patient's "non-affected side." However, several studies have challenged the assumption that unilateral stroke patients always have a non-affected upper extremity, reporting deficits in motor performance of the ipsilesional arm that cannot be attributed to apraxia, visuospatial neglect, or overarching cognitive impairments (Assadi et al., 2022; Barry et al., 2020; Hermsdörfer et al., 1999; Maenza et al., 2020; Pohl et al., 1997; Schaefer et al., 2007; Subramaniam et al., 2019; Winstein & Pohl, 1995). Although these ipsilesional deficits appear less severe compared with the contralateral side (Pellegrino et al., 2021), Maenza et al. (2020) found a significant positive correlation between a patient's severity of contralesional deficits and their severity of ipsilesional deficits. For example, people with severe contralesional impairment took significantly longer to perform the Jebsen–Taylor Hand Function Test (Jebsen et al., 1969) with their non-affected side compared with people with mild contralesional deficits (Maenza et al., 2020). Of note, these ipsilesional deficits also appear to differ depending on the hemisphere that is damaged (Pellegrino et al., 2021; Schaefer et al., 2007, 2009a, 2009b; Varghese & Winstein, 2020).

In a series of studies that compared ipsilesional arm reaching performance between LHS and RHS patients, Schaefer et al. (2007, 2009b) showed that LHS patients had larger reach curvatures and greater variability in initial reach direction compared with control participants using their left hand. These patients demonstrated similar accuracy at the end of each reach, stopping on the center of the target as consistently and accurately as control participants. RHS patients demonstrated an opposite pattern: similar reach trajectories and curvatures compared with controls but a disrupted ability to accurately stop at the end of the reach. Taken together, these studies show that ipsilesional deficits following unilateral stroke, although most often not as severe as contralesional deficits, are dependent on the hemisphere affected and cause functional disruptions in occupational performance. These deficits have been quantified with a variety of measures, including the Jebsen–Taylor Hand Function Test; the Box and Block Test; the Grooved Pegboard Test (Matthews & Klove, 1964); and tests measuring grip strength, reaction time, and movement kinematics. These deficits scale with a person's stroke severity and have been correlated with measures of ADL and IADL participation, with greater ipsilesional deficits corresponding to greater disruptions in functional independence (Assadi et al., 2022; Chestnut & Haaland, 2008; Maenza et al., 2020; Poole et al., 2009; Razak et al., 2022; Wetter et al., 2005). Therefore, the "nonaffected side" in people with unilateral stroke may be better described as the "less affected" side: Unilateral lesions have bilateral consequences, in the form of bilateral deficits of the function specialized in the lesioned hemisphere. Most important, ipsilesional arm motor deficits are greatest in patients with severely impaired contralesional arms (Maenza et al., 2020). In this case, the contralesional arm is unable to be used for grasp and release and thus is not an effective manipulator. In such patients, the performance of ADLs becomes almost entirely dependent on the strength and dexterity of the ipsilesional arm. Therefore, motor deficits in the ipsilesional arm have a strong and direct effect on functional independence (Assadi et al., 2022).

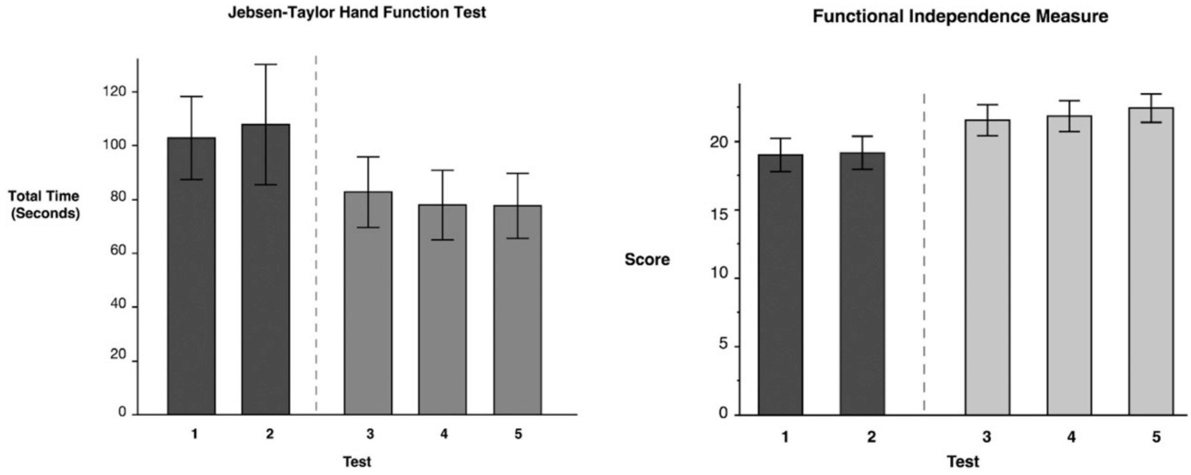
## Applications to Peripheral Nervous System Damage

People with unilateral upper extremity peripheral nerve injury (UE–PNI, or *PNI* for brevity) have intact hemispheric specializations for different features of movement control but cannot effectively deploy one of their hands. For most people with PNI, the ideal rehabilitation would involve restoration of function in the affected hand, but in practice this is often unachievable: Thirty-three percent to 39% of people with PNI never achieve satisfactory recovery after peripheral nerve repair surgery, regardless of any rehabilitation they may receive (Bailey et al., 2009; He et al., 2014; Philip et al., 2020; Ruijs et al., 2005). Therefore, many patients might benefit from directed training to use the intact nondominant hand to perform the high-precision actions that typically engage the dominant hand (i.e., *dominance-switching*). However, dominance-switching is not easily achieved: Despite the pressures of life and rehabilitation, most people with PNI continue to use their dominant hand, even when it is their less dexterous hand (Philip et al., 2022). Simply put, dominance-switching does not tend to occur in the absence of intense and directed training.

For patients to switch dominance, one necessary component is good performance with the nondominant hand. Patients can improve the performance of their nondominant hand with a few hours or days of activity-specific training, as described earlier, but these improvements are task specific and do not generalize to a broad change in handedness (Marcori et al., 2019). Task specificity is best demonstrated by "forced right-handers" (individuals born left-handed who were forced to write with their right hand). These individuals received years of writing practice with their nondominant hand, and as a result they use their right hand for writing but still prefer their left hand for other activities (Klöppel et al., 2007). This lack of generalization does not arise from fundamental limits in the brain: People with chronic amputation of the dominant upper extremity—who have performed all activities with the nondominant hand for years—demonstrate elevated (near–dominant-like) performance with the nondominant hand, even in the absence of activity-specific training (Philip & Frey, 2014). Therefore, good (near–dominant-like) performance with the nondominant hand may be challenging to achieve, but under the right circumstances the human brain is likely capable of substantial compensation.

The brain mechanisms of hand dominance-switching are not yet well understood. At least three mechanisms are possible: (1) changes in the nondominant hemisphere, (2) increased descending ipsilateral control via uncrossed fibers in the corticospinal tract, or (3) increased interhemispheric communication from the dominant hemisphere to the nondominant hemisphere. (By *dominant hemisphere* we mean "hemisphere contralateral to the dominant hand"; neither hemisphere is truly "dominant" over the other because, as described, the two cerebral hemispheres contain complementary specializations for movement control.) One line of research favors the third explanation, that is, changes in the nondominant hemisphere. Philip and Frey (2014) used functional MRI (fMRI) during performance of a precision drawing task and determined that nondominant hand performance was correlated with increased involvement of the left (ipsilateral to movement) motor cortex. In subsequent

**Figure 2. Motor capacity and functional independence improvements among individuals with chronic stroke after targeted ipsilesional arm training.**



*Note.* Left panel: Jebsen–Taylor Hand Function Test scores at baseline (Tests 1 and 2) and after targeted ipsilesional limb training (Tests 3–5). Right panel: FIM scores at baseline (Tests 1 and 2) and after targeted ipsilesional limb training (Tests 3–5). Baseline tests were conducted 3 wk apart. Posttests were conducted immediately after ipsilesional arm training (Test 3), followed by a 3- and 6-wk follow-up (Tests 4 and 5, respectively). All posttests (light gray) were significantly different ($p < .05$) from baseline measurements (dark gray). From “Remedial Training of the Less-Impaired Arm in Chronic Stroke Survivors With Moderate to Severe Upper-Extremity Paresis Improves Functional Independence: A Pilot Study,” by C. Maenza, D A. Wagstaff, R. Varghese, C. Winstein, D. C. Good, and R. L. Sainburg, 2021, *Frontiers in Human Neuroscience, 15,* 645714. https://doi.org/10.3389/fnhum.2021.645714. CC BY.

studies involving resting-state fMRI, the same researchers identified interhemispheric changes associated with nondominant hand learning: Nondominant hand learning was associated with increased connectivity between the bilateral sensorimotor cortex and a left-lateralized parieto–frontal network for manual skill (Philip & Frey, 2016) and predicted by interhemispheric connectivity from the left primary motor cortex and intraparietal cortex onto the left superior parietal lobule (Philip et al., 2021). Together, these results indicate that increased interhemispheric communication (Mechanism No. 3) must play a role in supporting increased function of the nondominant hand. Therefore, our hypothesis for the neural mechanism of dominance-switching is that it occurs when the nondominant hemisphere draws on its contralateral twin’s unique specializations for precision movement.

## Implications for Occupational Therapy Practice

### Implications for Stroke Rehabilitation

Occupational therapists aim to support their clients’ engagement in meaningful occupations. Because of the specializations of each hemisphere for different aspects of motor control, occupational therapists in stroke rehabilitation settings should consider each client’s premorbid handedness during evaluation and intervention planning, along with their specific hemisphere affected by the stroke. The consideration of each arm’s complementary role in different aspects of ADLs and IADLs will allow occupational therapists to better understand how specific deficits may affect meaningful participation for their clients.

Clinicians should also assess both contralesional and ipsilesional deficits, because these have been shown to covary and correlate with functional independence in people with chronic stroke (Maenza et al., 2020). In a preliminary study conducted by Maenza et al. (2021), people with chronic unilateral stroke (>6 mo poststroke) received 3 wk of targeted ipsilesional arm training (3 sessions/wk, 1.5 hr/session). This training addressed hemisphere-specific motor control deficits that were dependent on which hemisphere was damaged. Despite these participants being in the chronic phase of stroke, they demonstrated significant improvements on the Jebsen–Taylor Hand Function Test after training (Figure 2, left). These individuals also reported 14.38% higher scores on the self-care portion of the FIM®, and these scores were maintained at both 3-wk and 6-wk follow-up sessions (Figure 2, right).[1] It is important to note that the authors showed that this training, focused on the ipsilesional limb, was not associated with a detriment in upper extremity function for the more-affected contralesional limb, based on pre- and posttest upper extremity Fugl-Meyer scores.

We should note that the extensive research cited about ipsilesional arm deficits in patients with adult stroke are likely relevant to those with neonatal stroke (hemiparetic cerebral palsy). However, because of the

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[1] FIM® is a trademark of the Uniform Data System for Medical Rehabilitation, a division of UB Foundation Activities, Inc.

developing nature of the brain after neonatal stroke (Carlson et al., 2017), it is not currently known whether the same ipsilesional sequelae of unilateral stroke might be present in individuals who have experienced stroke so early in life because of the potential for developmental neural reorganization. Currently, a small number of studies do suggest that children with hemiparetic cerebral palsy demonstrate ipsilesional arm deficits similar to those quantified in adults with hemiparesis due to stroke (Hawe et al., 2020; Kuczynski et al., 2018).

Taken together, the studies just described suggest that ipsilesional deficits poststroke should be addressed from a remediation perspective (i.e., an intervention approach designed to restore function in the arm). To be specific, when the dominant arm is contralesional, remediation should involve dominance-switching to promote dominant-like function and use of the ipsilesional nondominant arm. The recovery stage at which this remediation might yield optimal results remains unclear. Preliminary clinical trials have focused on people in the chronic phase of stroke (Maenza et al., 2021; Pandian et al., 2014), whereas more research is needed to investigate ipsilesional arm training in acute and subacute phases. Currently, physical rehabilitation of the upper extremities is, understandably, focused on rehabilitation of the contralesional limb. However, many ADLs and IADLs require bilateral use of the upper extremities; thus, it has been suggested that clinicians could more effectively promote the use of both limbs through functional, bilateral training (Waller & Whitall, 2008). Indeed, a meta-analysis of bilateral arm interventions in stroke patients found significant positive effects of this type of intervention across all three phases of stroke (Cauraugh et al., 2010). More important, in patients with severe contralesional paresis who do not have the ability to manipulate objects functionally with the contralesional hand, the ipsilesional hand is the only functional manipulator. In this case, ipsilesional motor deficits are compounded in affecting functional independence. A number of studies of stroke survivors has demonstrated that ipsilesional arm deficit severity can predict functional independence in patients with unilateral stroke (Assadi et al., 2022; Chestnut & Haaland, 2008; Maenza et al., 2020; Razak et al., 2022).

## Implications for Peripheral Nerve Injury

After peripheral nerve injury, many people have chronic impairment of the dominant hand and could potentially benefit from increasing their use of the nondominant hand. These clients have intact brain mechanisms for dominant hand performance, on which the brain may be able to draw for successful movement with the intact nondominant hand. However, this process does not naturally occur during the course of therapy and daily life: Except in cases where the dominant hand is so impaired that it is completely unusable, people continue to use their premorbid dominant hand, even though it is no longer their most dexterous hand (Philip et al., 2022). If a client might benefit from increased use of their nondominant hand, the therapist will have to provide a rehabilitation program focused on this outcome. Unfortunately, few established therapies currently exist to achieve dominance-switching.

Therapists should take care to distinguish handedness (action choices) from self-report preferences and lateralized performance because these three constructs often diverge. As a result, rehabilitation approaches that are designed to change performance will not necessarily lead to changes in handedness. Therapists must distinguish among these three constructs to accurately identify, and remediate, the activity challenges faced by people with unilateral impairment.

## Conclusion

We have briefly discussed the evidence surrounding hemispheric specializations for motor control that may contribute to handedness and how these features may be altered after central or peripheral nerve injury. In this narrative review, we integrated relevant research from the fields of movement science, neuroscience, and occupational science, to promote translation of evidence into clinical practice (Sainburg et al., 2017). However, we should note that we did not follow a systematic protocol during development of this review. Thus, future systematic or scoping reviews may be necessary to minimize bias and provide a more comprehensive discussion of this topic.

It is vital that occupational therapists and other rehabilitation specialists consider handedness and hemispheric lateralization during evaluation and treatment. With an increased understanding of the basic neural mechanisms surrounding handedness, clinicians will be better able to implement targeted, evidence-based neurorehabilitation interventions to promote functional independence. We propose that, after unilateral impairment of the dominant arm, appropriate remediation should involve dominance-switching to promote function and use of the less-affected arm.

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