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### Cover Page Footnote

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# Using the Capabilities-Opportunity-Motivation-Behavior (COM-B) System to Conceptualize the Legalization of Sunday Migratory Game Bird Hunting

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## ABSTRACT

Recent wildlife agency efforts aimed at hunter recruitment, retention, and reactivation (R3) are examples of behavior change interventions. Therefore, these R3 programs and policies should be strategically designed to meet hunters' goals and motivations. We analyzed survey responses (n=808) from North Carolina resident migratory bird hunters regarding potential Sunday hunting legalization to serve as an illustrative case demonstrating how the capabilities-opportunity-motivation-behavior (COM-B) system can be used to conceptualize and more effectively test potential hunter behavior changes prompted by debated R3 strategies. Findings provide decision-makers and land managers with an understanding of the potential implications of migratory game bird Sunday hunting legalization, which offers insights into the types of interventions that may be most effective for increasing hunter participation.

## KEYWORDS

Behavior change, COM-B system, conservation, hunting policy, R3

## INTRODUCTION

The percentage of Americans participating in hunting and fishing has declined steadily for several decades due to a multitude of factors, including negative media coverage, competing forms of recreation, and urbanization (Vayer et al. 2021). These participation reductions have caused concerns regarding the sustainability of state agency funding to support wildlife conservation and management (Zhang and Miller 2019). As such, there has been a recent emphasis on hunter recruitment, retention, and reactivation (R3) efforts, which are aimed at increasing hunter numbers and associated funding (Vayer et al. 2021). Although these R3 programs and policies can take many forms (e.g., training workshops, urban recruitment programs; Zhang and Miller 2019), in essence, they are behavior change interventions in that they are coordinated activities meant to change behavioral patterns (Michie, Van Stralen, and West 2011). Yet the efficacy of R3 efforts remains uncertain as programs and policies appear to often misunderstand subgroups of potential hunters and over-rely on recruiting using traditional marketing tactics (Vayer et al. 2021).

The COM-B system is a model of behavior that can assist with designing behavior change interventions by pinpointing aspects of the behavior system that need to be addressed. Although it has predominantly been utilized in the health sciences (e.g., in designing interventions to improve hearing-aid use in adult auditory rehabilitation [Barker, Atkins, and de Lusignan 2016] and smart food policies for obesity prevention [Hawkes et al. 2015]), we seek a novel application of the COM-B system by applying it to the conceptualization of R3 efforts and associated potential behavior change. The system consists of three conditions of behavior change: capabilities (an individual's psychological and physical ability to engage), opportunities (external factors that influence if it is possible for an individual to engage), and motivations (the conscious and subconscious processes that energize and direct actions) (Figure 1; Michie et al. 2011). Capabilities and opportunities influence motivation, and all three conditions affect behavior. Behavior change generates a feedback loop that influences COM (Figure 1). The COM-B system is lauded for allowing decision-makers to target the specific barrier condition(s) required to prompt a behavior change (Michie et al. 2011), which would be helpful to agencies seeking to increase hunting activity in general or perhaps misunderstanding why change is slow or non-existent. Thus, rather than relying on broad brushstroke marketing (Vayer 2021),

agencies could identify the capability, opportunity, and motivational barriers hindering behavior change among specific hunter segments.

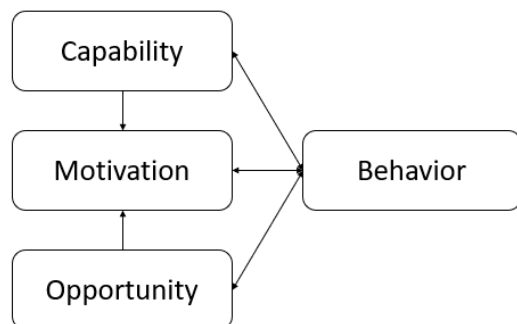


Figure 1: The COM-B system, per Michie, Van Stralen, and West (2011)

Legalizing the Sunday hunting of migratory game birds in North Carolina makes for an exemplary case study of applying the COM-B system to R3 efforts in that ongoing debates regarding legalization are centered on how the proposed policy adjustment will induce hunter behavior change. The current prohibition on the Sunday hunting of migratory game birds in North Carolina is one of the few remaining “blue laws,” or restrictions from colonial times that were placed on specific activities to compel Sunday as a day of rest and prayer. Currently, eleven east coast states have either Sunday hunting bans or restrictions (e.g., only permitted on private lands, in limited instances, or in select counties) (John Durham and Assoc. 2011).

To better understand how such Sunday hunting legalization policy changes may affect stakeholders, many of these states and related organizations have conducted research to identify perceptions of Sunday hunting and its potential impacts. These studies find approximately 50-70 percent of hunters support removing Sunday hunting restrictions, whereas opposition ranges from approximately 30-40 percent of hunters (Jagnow and Ellis 2007; Responsive Management 2018), indicating mixed-to-general support for Sunday hunting. Beyond providing another opinion poll estimating support for/opposition to Sunday hunting legalization (e.g., Jagnow and Ellis 2007; Responsive Management 2018), our objective is to explore the potential behavior changes associated with the legalization of Sunday migratory bird hunting in North Carolina and use these results in a post-hoc manner to demonstrate how the COM-B system (Michie et al. 2011) can be used to more effectively test potential behavior change prompted by debated R3 strategies. Improving understandings of potential behavior change can inform R3 efforts by helping policymakers

contextualize their decision-making and integrate such potential behavior changes with support and opposition arguments (e.g., Jagnow and Ellis 2007; John Durham and Assoc. 2011; Responsive Management 2018).

## METHODS

### *Study Area*

North Carolina serves as an example of a state that has been slowly altering their approach to hunting blue laws. The Outdoor Heritage Act of 2015 removed the absolute prohibition of firearms hunting on Sundays, and the Outdoor Heritage Enhanced Act, signed in 2017, provided enhanced opportunities to hunt on Sundays in North Carolina. This act provided changes for Sunday hunting on private lands, most notably allowing hunting within 500 yards of a residence (North Carolina Wildlife Resources Commission [NCWRC] 2017). Additionally, it gave the NCWRC and other public landowners and land managers the authority to implement new options for Sunday hunting on public lands under their jurisdiction. Yet the hunting of migratory birds on Sunday continues to be prohibited under the Outdoor Heritage Enhanced Act, although the legislation granted NCWRC the authority to lift this prohibition after March 1, 2018. The law also mandated that research be conducted to analyze the ecological, economic, and social impacts associated with migratory bird hunting on Sundays to aid in future decision-making efforts related to permitting the hunting of migratory birds on Sunday (NCWRC 2017). Although there is documented general support for the Sunday hunting of migratory game birds in North Carolina, there is still active debate among the approximately 68,649 dove and 45,970 duck hunters (per 2017-2018 season estimates, NCWRC 2018), and a more detailed exploration of potential behavioral changes of hunters is required (Responsive Management 2018).

### *Data Collection and Analysis*

The NCWRC designed this study and generated a random sample of resident North Carolina Federal Harvest Information Program (HIP)-certified migratory bird hunters. Resident HIP-certified hunters were the focus of this study because the NCWRC aimed to prioritize local constituents in their analysis of potential policy change. The sampling frame was given to Responsive Management, Inc. staff, who contacted prospective respondents via telephone from December 2017 through January 2018 to seek their participation in the survey. Responsive Management used a five-callback design to maintain representativeness

and avoid bias by individuals who were easier to reach (Duda and Nobile 2010). North Carolina State University human subjects research standards were followed to protect the subjects involved in this study. Survey questions were designed cooperatively by the NCWRC and Responsive Management, who was responsible for pretesting (per Alaimo, Olson, and Frongillo 1999).

Survey questions focused on respondents' current and anticipated hunting behaviors should Sunday migratory bird hunting be legalized as they pertain to potentially increasing hunting participation (i.e., improving R3 efforts), where each set of items can be linked back to a COM-B component (or multiple components, Michie et al. 2011). For example, Ryan and Shaw (2011) observed that socialization into hunting culture is necessary for novice hunters, thus hunters should seek to mentor non-hunter family members, friends, and youths interested in hunting. This sentiment was translated into a survey item measuring respondents' interest in taking a family member, friend, or youth migratory bird hunting on a Sunday, which may be a relationship-based motivation and/or interest in expanding others' capabilities (Michie et al. 2011). Similarly, Zhang and Miller (2019) noted that hunting participation is often constrained by both access to land (private and public) and time to travel to locations/participate in hunting, thus the NCWRC and Responsive Management generated items measuring land ownership and willingness to permit Sunday hunting on that land, as well as items measuring frequencies and lengths of hunting trips, all of which address constraints to hunting opportunities (Michie et al. 2011). At the end of the survey, respondents were asked for their opinions regarding migratory waterfowl (e.g., duck, coot, goose, brant, and swan) and webless migratory bird (e.g., dove, rail, gallinule, moorhen, woodcock, and snipe) Sunday hunting, assuming the total number of hunting days remained the same. They could indicate if they strongly/somewhat supported Sunday hunting, strongly/somewhat opposed, neither supported nor opposed, or did not know (DK).

We performed analysis using IBM SPSS Statistics version 26.0. To determine whether support for either migratory waterfowl or webless migratory bird Sunday hunting resulted in differing attitudes or behaviors, we analyzed individuals' responses related to the legalization of Sunday hunting. We compared the answers of three exclusive groups: 1) those who supported, 2) those who opposed, or 3) those who neither supported nor opposed or didn't provide an opinion (collapsed together for analysis purposes). We used Chi-square tests for comparisons of nominal

variables (McDonald 2014) and used Cramér's V as a measure of effect size (where we interpreted 0.01 as small, 0.06 as medium, and 0.14 as large; Warner et al. 2022). We tested for differences of means using one-way ANOVAs (McDonald 2014) and used partial eta squared ( $\eta^2$ ) as a measure of effect size (Warner et al. 2022).

## RESULTS

We analyzed 808 completed responses, which allowed for statistical inferences to be made at the 95 percent confidence level. Nearly all respondents were male (97.0 percent) and ages ranged between 18 and 85, with a mean age of 44.4 ( $SD=15.99$ ). Nearly half (45.8 percent) had some college or trade school or fewer years of education, about a third of respondents (34.4 percent) had a bachelor's or higher degree, and a few (16.1 percent) had an associate's degree or completed a trade program. All respondents had hunted migratory game birds in North Carolina during the previous five hunting seasons (September 2012 to March 2017), with the majority (80.4 percent) of respondents having hunted webless migratory birds and over half (58.8 percent) having hunted migratory waterfowl during that period.

Few respondents were explicitly opposed to legalizing Sunday hunting of migratory waterfowl and webless migratory birds in North Carolina, yet responses were generally split between explicit support for legalization and neither supporting nor opposing legalization in both cases (Table 1). Support for legalizing Sunday hunting of migratory waterfowl positively correlated with support for legalizing Sunday hunting of webless migratory birds,  $r(806)=0.56$ ,  $p=.020$ .

Table 1: Support for the Legalization of Sunday Hunting of Migratory Waterfowl and Webless Migratory Birds

		Legalization of Sunday Hunting of Webless Migratory Birds			<b>Total</b>
		Support	Oppose	Neither/DK	
Legalization of Sunday Hunting of Migratory Waterfowl	Support	19.9%	0.1%	17.5%	37.5% (303)
	Oppose	0.7%	8.4%	6.4%	15.6% (126)
	Neither/DK	20.9%	10.1%	15.8%	46.9% (379)
	<b>Total</b>	41.6% (336)	18.7% (151)	39.7% (321)	100% (808)

Approximately 70 percent of all respondents indicated that if Sunday hunting were legalized they would take a family member, friend, and/or youth migratory bird hunting on a Sunday, and their responses



regarding the legalization of Sunday hunting of migratory waterfowl and webless migratory birds consistently had a statistically significant association with their interest in taking a family member, friend, and/or youth on a Sunday hunting trip (Table 2). Of the 26.7 percent of respondents who owned land and used it for migratory bird hunting, 65.7 percent would permit hunting on their lands on Sundays (Table 2). Respondents' responses regarding the legalization of Sunday hunting of migratory birds did not appear to be significantly related to their land ownership status (migratory waterfowl: [ $\chi^2$  (4, N=808)=3.000,  $p=.558$ ], and webless migratory birds: [ $\chi^2$  (4, N=808)=10.117,  $p=.039$ ], although the effect size for this finding, Cramér's  $V$ , was .08). However, responses regarding Sunday hunting legalization did have a statistically significant relationship with permitting hunting on those lands on Sundays (Table 2).

The majority of respondents (60.1 percent) indicated they would hunt about the same number of days on day trips if Sunday hunting were legalized, 33.3 percent would hunt more days on day trips, 4.2 percent were unsure, and 2.4 percent would hunt fewer days on day trips. Respondents' responses regarding the legalization of Sunday hunting of migratory waterfowl [ $\chi^2$  (6, N=808)=113.251,  $p\leq.001$ ; Cramér's  $V=.26$ ] and webless migratory birds [ $\chi^2$  (6, N=808)=72.623,  $p\leq.001$ ; Cramér's  $V=.21$ ] had a statistically significant association with expected day trips taken. When asked how the number of days respondents would spend hunting game birds on overnight trips would change if the legalization of Sunday hunting occurred, fewer respondents (22.3 percent) predicted they would hunt more days, 65.1 percent indicated about the same number of days, 7.9 percent were unsure, and 4.7 percent said fewer days. Again, respondents' responses regarding the legalization of Sunday hunting of migratory waterfowl [ $\chi^2$  (6, N=808)=116.607,  $p\leq.001$ ; Cramér's  $V=.27$ ] and webless migratory birds [ $\chi^2$  (6, N=808)=42.050,  $p<.001$ ; Cramér's  $V=0.16$ ] had a significant association with expected overnight trips.

We further investigated these respondents' estimations on anticipated travel changes and, on average, the respondents who believed they would hunt on more day trips predicted they would hunt an additional 6.60 days per year. On average, the respondents who believe they would hunt on more overnight trips predicted they would add 4.80 days to their overnight trips (Table 3). Respondents' responses regarding the legalization of Sunday hunting of migratory waterfowl had a significant association with the number of additional days they would spend on single-day hunting trips and overnight trips, however their responses

Table 2: Potential Behavior Changes if Sunday Hunting Were Legalized by Responses Regarding Legalization of Sunday Hunting for Both Migratory Waterfowl and Webless Migratory Birds

		Legalization of Sunday Hunting of Migratory Waterfowl					Legalization of Sunday Hunting of Webless Migratory Birds					
		Total	Support	Oppose	Neither/DK	X <sup>2</sup> Stat. (p-value)	Cramér's V	Support	Oppose	Neither/DK	X <sup>2</sup> Stat. (p-value)	Cramér's V
Take a Family Member Hunting on a Sunday	Yes	68.9%	93.4%	24.6%	64.1%	207.37 (≤.001)	.36	91.1%	19.9%	68.9%	262.8 (≤.001)	.40
	No	29.0%	5.6%	72.2%	33.3%			7.1%	78.8%	28.4%		
	DK	2.1%	1.0%	3.2%	2.6%			1.8%	1.3%	2.8%		
Take a Friend Hunting on a Sunday	Yes	70.7%	95.7%	27.8%	64.9%	213.41 (≤.001)	.36	93.2%	20.5%	70.7%	287.3 (≤.001)	.42
	No	27.4%	3.0%	69.1%	33.0%			5.4%	78.8%	26.2%		
	DK	2.0%	1.3%	3.2%	2.1%			1.5%	0.7%	3.1%		
Take a Youth Hunting on a Sunday	Yes	69.2%	91.4%	29.4%	64.6%	175.21 (≤.001)	.33	92.3%	21.2%	67.6%	262.1 (≤.001)	.40
	No	28.8%	7.9%	69.1%	32.2%			6.0%	77.5%	29.9%		
	DK	2.0%	0.7%	1.6%	3.2%			1.8%	1.3%	2.5%		
	Total n	808	303	126	379			336	151	321		
Allow Hunting on Land on Sundays	Yes	65.7%	93.4%	14.3%	62.9%	67.53 (≤.001)	.39	91.0%	12.2%	67.2%	94.62 (≤.001)	.47
	No	33.3%	6.6%	82.9%	36.2%			8.0%	87.8%	31.3%		
	DK	0.9%	0.0%	2.9%	1.0%			1.0%	0.0%	1.5%		
	Total n	216	76	35	105			100	49	67		

Table 3: Potential Additional Days Spent Hunting Day Trips and Overnight Trips if Sunday Hunting Were Legalized by Responses Regarding Legalization of Sunday Hunting for Both Migratory Waterfowl and Webless Migratory Birds

		Legalization of Sunday Hunting of Migratory Waterfowl				
		N	Additional Days	SD	F Stat. (p-value)	$\eta^2$
Day Trip	Support	151	7.25	6.74	4.20 (.016)	.03
	Oppose	9	9.11	4.49		
	Neither/DK	86	5.20	4.01		
	Total	246	6.60	5.94		
Overnight Trip	Support	121	4.79	3.37	3.52 (.032)	.04
	Oppose	7	8.00	5.63		
	Neither/DK	42	4.29	3.16		
	Total	170	4.80	3.48		
		Legalization of Sunday Hunting of Webless Migratory Birds				
		N	Additional Days	SD	F Stat. (p-value)	$\eta^2$
Day Trip	Support	144	6.63	6.92	0.25 (.779)	.002
	Oppose	10	7.80	3.88		
	Neither/DK	92	6.41	4.25		
	Total	246	6.60	5.94		
Overnight Trip	Support	93	4.55	3.19	0.54 (.586)	.006
	Oppose	5	5.20	3.63		
	Neither/DK	72	5.10	3.84		
	Total	170	4.80	3.48		

regarding the legalization of Sunday hunting of webless migratory birds did not (Table 3).

## DISCUSSION

Overall, findings from this study suggest that the COM-B system (Michie et al. 2011) can serve as an effective and beneficial framework in which to develop and situate proposed R3 strategies. In this case, most broadly, legalizing Sunday hunting is addressing the condition of “opportunities” within the system because it aims to remove the external [legal] barrier preventing hunters who wish to participate in hunting on Sundays from

engaging. However, particular behavior changes explored in this study can be applied more specifically to multiple conditions within the COM-B system in a variety of ways. For example, respondents' interest in taking a family member, friend, or youth hunting on a Sunday can address the "capabilities" condition that may prevent inexperienced or non-hunter adults and youth from participating in hunting. Additionally, respondents' interest in permitting their own land to be used for hunting on Sundays increases hunting opportunities for others. Similarly, respondents' potential to increase their number of day/overnight hunting trips and the length of those trips serves as increased hunting opportunity. Framing Sunday migratory bird hunting legalization using the COM-B system (Michie et al. 2011) illuminates the multifaceted nature of this proposed R3 strategy and emphasizes how a policy change may influence behavior from multiple angles. Furthermore, the anticipated behavior changes that were self-reported among survey respondents highlight how different people's behaviors are shaped by a variety of conditions, thus a one-size-fits-all approach is not likely to be effective.

Other proposed R3 strategies can be modeled and further explored using the COM-B system. For example, increasing opportunities to hunt in hopes of increasing participation is often a cornerstone of R3 initiatives as evidenced by California, Georgia, Iowa, and Kentucky, the only states to implement official R3 statewide plans (Schummer et al. 2020). Expanding access and opportunity to facilitate hunter participation using strategies such as opening more land for hunting, increasing hunting hours, and reducing restrictions on hunting methods and equipment (USDOJ 2017), are all meant to address the condition of "opportunities" within the system and increase conservation revenue from taxes, fee stamps, and licenses. Other initiatives focus on increasing the number of hunters by improving capabilities. For example, efforts to diversify hunting in terms of the race, age, gender, and abilities of hunters seek to eliminate physical (e.g., firearms training) and psychological (e.g., cultural fit) barriers (Ryan and Shaw 2011; Serenari and Peterson 2018). Additionally, new calls to focus on hunt quality (Schummer et al. 2020) appeal to the "motivation" condition in that they target internal drivers. Just as our results highlight addressing dual conditions in terms of increasing opportunities and increasing capabilities, other R3 strategies that effectively leverage multiple conditions will likely be most efficient in terms of their impact.

Michie et al.'s (2011) behavior change wheel can assist with identifying effective interventions that address deficits in each of these conditions within the hunter participation COM-B system. Michie et al.

(2011) feature nine potential interventions in an effort to ensure that policymakers are familiar with the full range of alternatives. Combinations of interventions can be, and are currently, used by agencies seeking to improve R3 efforts (e.g., education and training), yet other alternatives are also available. For example, incentives can be used to encourage current hunters to recruit new family, friend, or youth participants, and restructuring can be used to test the effects of making more hunting lands available (e.g., initially only opening private lands to Sunday migratory bird hunting).

Conceptualizing potential hunter behavior changes within the COM-B system may be a helpful tool to policymakers, although it is important to recognize the limitations of this framing. Most notably, we acknowledge that self-reported anticipated behavior change is subject to hypothetical bias (Murphy et al. 2005) and that attitudes towards legalization may stem from various and possibly multiple sources. Additionally, although we explored anticipated direct potential behavior changes among migratory bird hunters, we have not investigated potential behavior changes of other hunters discussed in this survey (e.g., family/friends/youth hunters), hunters not addressed in this survey (e.g., potential behavior changes of other hunters in response to Sunday migratory bird hunting legalization), or other recreationists in response to the legalization policy change. We advocate for the use of the COM-B system to help conceptualize and test potential behavior changes among targeted groups, with the recognition that the COM-B system may apply differently across various hunter typologies or segments. Future research must test the efficacy of R3 interventions rooted in the COM-B system, as well as explore the relationships between competing behavioral conditions (e.g., hunting opportunity and hunting quality) to better equip policymakers to address the myriad of factors causing declines in hunter participation.

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#### DISCLOSURE STATEMENT

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