A Systematic Review on Functional Analysis of Noncompliance

Alyssa Hurd
Utah State University, alyssa.hurd@usu.edu

Follow this and additional works at: https://digitalcommons.usu.edu/etd2023

Part of the Psychology Commons

Recommended Citation
Hurd, Alyssa, "A Systematic Review on Functional Analysis of Noncompliance" (2023). All Graduate Theses and Dissertations, Fall 2023 to Present. 43. https://digitalcommons.usu.edu/etd2023/43
A SYSTEMATIC REVIEW ON FUNCTIONAL ANALYSIS OF NONCOMPLIANCE

by

Alyssa Hurd

A thesis submitted in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Psychology

Approved:

_________________________
Katherine Brown, Ph.D.
Major Professor

_________________________
Timothy Shahan, Ph.D.
Committee Member

_________________________
Timothy Slocum, Ph.D.
Committee Member

_________________________
D. Richard Cutler, Ph.D.
Vice Provost of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah
2023
ABSTRACT

A Systematic Review on Functional Analysis of Noncompliance

by

Alyssa Hurd, Master of Science

Utah State University, 2023

Major Professor: Dr. Katherine Brown
Department: Psychology

Noncompliance is a common caregiver concern that can have adverse effects on the learner. Although functional analysis is often employed for other forms of problem behavior (e.g., aggression, property destruction), it is infrequently conducted for noncompliance. Noncompliance is often hypothesized to be maintained by escape from demands. However, to date, no study has examined the prevalence of variables that maintain noncompliance or intervention outcomes despite their importance in informing intervention. Thus, the purpose of this review was to conduct a systematic literature review of published functional analysis of noncompliance to determine the prevalence of environmental variables that maintain noncompliance and subsequently examine the efficacy of noncompliance interventions based on functional analysis outcomes. Results indicate noncompliance was maintained by escape from demands in half of the studies identified, and consequence-based interventions were more efficacious than antecedent-based interventions.

(50 pages)
A Systematic Review on Functional Analysis of Noncompliance

Alyssa Hurd

Lack of following instructions is a common caregiver concern that can have adverse effects on the learner. Although certain behavioral assessments (i.e., functional analysis) are often employed for other forms of challenging behavior (e.g., aggression, property destruction) to determine why these behaviors are occurring (e.g., to gain attention, toys, or escape from instructions), these assessments are infrequently conducted to determine why a learner is not following instructions. Lack of following instructions is often hypothesized to be motivated by desire to escape from instructions. However, to date, no study has examined the prevalence of variables that motivate lack of following instructions or intervention outcomes despite their importance in informing intervention. Thus, the purpose of this review was to examine the published literature that assessed lack of following instructions to determine the prevalence of environmental variables that motivate lack of following instructions. Subsequently, we also aimed to examine the efficacy of interventions for increasing following instructions that were developed based on assessment results. Results indicate lack of following instructions was motivated by a desire to escape from instructions in half of the studies identified, and consequence-based interventions were more efficacious than antecedent-based interventions.
ACKNOWLEDGMENTS

I am grateful for my family, friends, and colleagues for their love, support, and guidance throughout this project’s evolution. Thank you for being an essential part of this milestone during my graduate career.

Alyssa Hurd
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>iii</td>
</tr>
<tr>
<td>Public Abstract</td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>v</td>
</tr>
<tr>
<td>Contents</td>
<td>vi</td>
</tr>
<tr>
<td>List Of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>List Of Figures</td>
<td>ix</td>
</tr>
<tr>
<td>Chapter I Introduction And Literature Review</td>
<td>1</td>
</tr>
<tr>
<td>Statement Of The Problem</td>
<td>3</td>
</tr>
<tr>
<td>Significance Of The Research</td>
<td>3</td>
</tr>
<tr>
<td>Purpose Of The Study</td>
<td>4</td>
</tr>
<tr>
<td>Chapter II Methodology</td>
<td>4</td>
</tr>
<tr>
<td>Inclusion Criteria</td>
<td>4</td>
</tr>
<tr>
<td>Interobserver Agreement</td>
<td>6</td>
</tr>
<tr>
<td>Dependent Variables</td>
<td>7</td>
</tr>
<tr>
<td>Chapter III Results</td>
<td>9</td>
</tr>
<tr>
<td>Demographics and Setting</td>
<td>10</td>
</tr>
<tr>
<td>Functional Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Intervention</td>
<td>13</td>
</tr>
<tr>
<td>Chapter IV Discussion</td>
<td>15</td>
</tr>
<tr>
<td>Summary</td>
<td>15</td>
</tr>
<tr>
<td>Extensions Of Current Literature</td>
<td>16</td>
</tr>
<tr>
<td>Potential Limitations</td>
<td>17</td>
</tr>
<tr>
<td>References</td>
<td>21</td>
</tr>
<tr>
<td>Tables</td>
<td>30</td>
</tr>
<tr>
<td>Figures</td>
<td>32</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1. Intervention Descriptions</td>
<td>30</td>
</tr>
<tr>
<td>Table 2. Case Characteristics</td>
<td>31</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1. PRISMA Flow Diagram</td>
<td>..........................</td>
<td>32</td>
</tr>
<tr>
<td>Figure 2. Antecedent-Based Intervention Efficacy by Function</td>
<td>..........................</td>
<td>33</td>
</tr>
<tr>
<td>Figure 3. Consequence-Based Intervention Efficacy by Function</td>
<td>..........................</td>
<td>34</td>
</tr>
</tbody>
</table>
In general, noncompliance has been defined as failure to perform an instructed task and is a common parental concern estimated to occur in 25% to 65% of children (Kalb & Loeber, 2003). In fact, noncompliance is a primary reason for referral to outpatient behavioral health clinics (Axelrod et al., 2014; Kalb & Loeber, 2003; McMahon & Forehand, 2003). Persistent noncompliance can negatively affect social interactions with adults and peers by creating stressful situations (Cipani, 1993; Kalb & Loeber, 2003) and may increase a learner’s risk of physical injury if they do not follow safety instructions (Kalb & Loeber, 2003). Persistent noncompliance is also associated with the emergence of aggression and antisocial behavior (McMahon et al., 2011), substance abuse, and conduct disorder, making early intervention critical (Cipani, 1993; Kalb & Loeber, 2003; McMahon et al., 2011).

Noncompliance in academic settings can be particularly problematic. Learners who engage in noncompliant behavior in the classroom directly impede learning for themselves, may indirectly interfere with their peers’ learning, and can even pose a danger to others in the form of escalated problem behavior (Cipani, 1993; Luiselli, 2009). As a result, the noncompliant learner may be removed from the classroom, placed in nontraditional academic environments, or suspended, further impeding their learning opportunities (Cipani, 1998). These learners may also be unable to participate in structured classroom activities, miss opportunities for physical exercise, have limited social interactions with peers, and be prevented from attending outings (Kalb & Loeber, 2003).
Noncompliance is often hypothesized to be maintained by escape from demands (Kalb & Loeber, 2003; Lipschutz & Wilder, 2017; Richman & Wacker, 2001). However, an experimental functional analysis (FA; Iwata et al., 1994) is only sometimes conducted to confirm this hypothesis (Lipschultz & Wilder, 2017). For example, Beavers et al. (2013) conducted a systematic review of published studies that utilized FA to identify the function of a wide range of problem behaviors. Of the total 435 studies reviewed by Beavers et al. (2013) and Hanley et al. (2003), only 25 (5.7%) employed FA to identify the function of noncompliance. Within the 25 studies, 25 cases assessed noncompliance and indicated noncompliance was most often maintained by escape and attention with fewer maintained by multiple sources of reinforcement or access to tangibles. As such, the prevalence of environmental variables maintaining noncompliance remains largely unknown relative to other problem behavior topographies (e.g., stereotypy has a higher prevalence of automatic reinforcement; Beavers et al., 2013; Hanley et al., 2003).

Although several interventions are designed to increase compliance (Kalb & Loeber, 2003; Lipschutz & Wilder, 2017; Radley & Dart, 2016), failure to identify environmental variables that maintain the learner’s noncompliance can result in a loss of resources, such as finances and time (Mace, 1994), the use of ineffective or contraindicated interventions (Hanley et al., 2003; Mace, 1994; Rodriguez et al., 2010), and restrictive interventions (e.g., time-out, response cost, reprimands, physical restraint; Magee & Ellis, 2001). For example, time-out is frequently recommended to address problem behavior, including noncompliance (American Academy of Pediatrics, 2018; Centers for Disease Control & Prevention, 2019). Although time-out may be an efficacious intervention for a learner whose noncompliance is maintained by attention,
this procedure would likely exacerbate noncompliance for a learner from whom noncompliance functions to escape demands (Carr & Durand, 1985; McMahon & Forehand, 2003; Rodriguez et al., 2010). Linking the prescribed interventions for noncompliance with the results of an FA reduces the likelihood of a contraindicated intervention and may increase the efficacy of the treatment (e.g., Filter & Horner, 2009; Ingram et al., 2005; Payne et al., 2007; Rispoli et al., 2015).

Although previous reviews have examined the efficacy of various interventions for noncompliance (e.g., Lipschultz & Wilder, 2017; Radley & Dart, 2016), such interventions are often not informed by the outcomes of an FA. Given that intervention efficacy varies based on the environmental variables maintaining behavior (Filter & Horner, 2009; Ingram et al., 2005; Payne et al., 2007; Rispoli et al., 2015), reviews of noncompliance interventions need to link the efficacy of these interventions to the assessment results. Variability in intervention efficacy for noncompliance has been observed in previous studies, which may be due to a lack of developing function-based interventions (e.g., Fischetti et al., 2012; Lipschultz et al., 2017; Wilder & Atwell, 2006). For example, McKerchar and Abby (2012) found that time-out was ineffective at increasing compliance for two participants. In contrast, Handen et al. (1992) found this intervention effective for four of five participants. Given that only one of these studies conducted an FA of noncompliance (McKerchar & Abby, 2012), the varying levels of efficacy for time-out may have been due to different functions of noncompliance. This highlights a gap in the broader understanding of the environmental variables evoking and maintaining noncompliance and a need for more efficacious interventions to be developed and evaluated.
The purpose of this review was to identify published studies that conducted an FA of noncompliance to determine the prevalence of environmental variables maintaining noncompliance. A second purpose was to determine the efficacy of various function-based interventions for noncompliance.

Method

Inclusion Criteria

Article Inclusion

We conducted an electronic search of the PsycINFO database and Google Scholar using the key terms (1) functional analysis of noncompliance; (2) functional analysis of compliance; (3) maintained noncompliance; and (4) noncompliance with the “or” modifier between each term. We selected these two databases as other databases (e.g., ProQuest) did not return nonduplicated articles that met our inclusion criteria. We selected the listed search terms as they were the most common terms to appear in studies that conducted an FA. We did not include abbreviations such as “FA” in our key terms as the full term would first appear in studies following APA guidelines. We included articles if they (1) were published between the years 1994 and 2020; (2) were published in a peer-reviewed journal; (3) were written in English; (4) included human subjects; and (5) conducted an FA of noncompliance. We selected 1994 as the beginning year of our search criteria as it is consistent with the date of publication of Iwata et al.’s (1994) seminal work establishing the importance of conducting FAs for problem behavior.
Figure 1 contains the PRISMA flow diagram depicting the search process. The initial database search and reference list review returned 2,168 articles (2,047 from PsycINFO and 21 from Google Scholar). After removing 38 duplicates, we reviewed the title and abstract of the remaining 2,030 articles to assess whether they met the inclusion criteria. Researchers reviewed the full text if it was unclear whether an article met inclusion criteria based on screening the title and abstract. Of the returned 2,030 articles, 2,010 did not meet the inclusion criterion of conducting an FA of noncompliance. Researchers reviewed the full text of the remaining 20 articles and excluded an additional 8 articles. Reasons for exclusion included the use of indirect measures and lack of tests for functional reinforcers. Finally, researchers reviewed the reference lists of included articles to identify studies published between 1994 and 2020 and then applied the inclusion criteria stated above. We identified 100 articles from the reference lists and removed two duplicate articles, resulting in 98 articles eligible for screening, which did not yield additional articles for inclusion. Thus, we included a total of 12 articles in the present study.

Case Inclusion and Exclusion

Within each article, we included cases that demonstrated experimental control according to Monahan et al. (2011) for the FA (i.e., the manipulation of compliance under at least two conditions). We excluded cases if researchers examined noncompliance as a free operant or conducted fewer than three data points per FA condition. We excluded cases that measured noncompliance as a free operant, given the methodological limitation that noncompliance can only occur in response to an
instruction (Rodriguez et al., 2010). We identified 38 cases from the included articles and excluded 7, resulting in 31 cases. The primary reason for exclusion of cases was that not all participants in the respective studies experienced an FA for noncompliance.

**Interobserver Agreement**

For article interobserver agreement (IOA), a second data collector randomly selected 33% (n = 670) of all articles returned during the initial search without duplicates to assess the reliability of article inclusion. We used the exact agreement method to calculate interobserver agreement by dividing the number of articles in agreement for inclusion by the total number of articles returned and multiplying this quotient by 100%. If data collectors disagreed about including an article, they met to discuss the rationale until they reached an agreement. The second data collector included 4 articles from the sample of 670. Interobserver agreement for article inclusion was 99%. The secondary coder excluded one article from the sample that met the inclusion criteria. Likewise, a second data collector randomly selected 33% of all cases from included articles to assess IOA of case inclusion. We used the same agreement method described above. Interobserver agreement for case inclusion was 100%. Finally, a second data collector randomly selected 12 of the 31 cases (i.e., 38%) and independently coded dependent variables to assess case IOA. Agreement was assessed using the exact count per variable by comparing the coded data from the two independent data collectors. We scored an agreement if the data collectors scored an identical response and a disagreement if the responses were not identical. Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and converting
that into a percentage. Agreement between data collectors was 100% for age, ethnicity, session therapist, antecedent and consequence intervention, intervention type, and categorization of intervention efficacy into percentage of nonoverlapping data (PND) categories. Interobserver agreement was 98.6% for FA test conditions; 91.6% for sex, type of experimental control, and session length; 90.3% for FA outcomes; 83.3% for diagnoses; and 75% for FA setting, experimental design, and total time in the assessment. For cases in which interobserver agreement was less than 100%, the data collectors collectively reviewed discrepancies, came to an agreement, and made updates accordingly.

Dependent Variables

Given the variability in definitions of noncompliance within the literature, we defined noncompliance broadly to capture a wide array of definitions. We defined noncompliance as failure to initiate or complete a task following the presentation of an instruction to complete the task within a specified amount of time (e.g., 5 s, 10 s) and/or engaging in problem behavior (e.g., aggression, disruption, vocal protest) following the instructional presentation. For each case of noncompliance, we coded demographic, setting, FA, and intervention variables.

Demographic and Setting

For each case, we collected: (1) age; (2) sex; (3) ethnicity; (4) developmental and behavioral diagnoses; (5) setting (i.e., school, clinic, home, early education center); and (6) session implementer (i.e., behavior therapist, teacher, caregiver, researcher, or a
combination of any two types if a case experienced multiple session implementers).

**Functional Analysis**

Data collectors scored the following FA variables: (1) experimental test conditions (i.e., tangible, attention, escape, ignore, and/or synthesized [i.e., authors provided two or more stimuli contingent on noncompliance]); (2) author-reported variable(s) maintaining noncompliance; (3) session duration; (4) total time in assessment; (5) experimental design (i.e., multielement, reversal, pairwise, trial-based, or brief, based on definitions provided by Cooper et al., 2007); and (6) method of experimental control (i.e., contingency reversal, extinction, noncontingent reinforcement; based on definitions provided by Thompson & Iwata, 2005).

**Intervention**

For each case, data collectors coded whether therapists implemented a function-based intervention (i.e., intervention manipulated the environmental event maintaining noncompliance as determined by the FA). For each intervention, data collectors coded if the intervention was antecedent- and/or consequence-based according to the definitions provided by Lipschultz and Wilder (2017). Interventions were coded as “antecedent” if the implementer manipulated stimuli prior to the presentation of the instruction to increase the probability of compliance (e.g., high-probability demand sequence). Interventions were coded as “consequence” if the implementer manipulated stimuli after the presentation of the instruction to increase the probability of compliance (e.g., differential reinforcement). No cases used both antecedent- and consequence-based
strategies (e.g., advanced notice with guided compliance). Data collectors also coded the type of intervention based on the following categories: (1) noncontingent reinforcement (NCR); (2) high-probability instructional sequence; (3) warning; (4) rationales; (5) differential reinforcement of alternative behavior (DRA); (6) DRA with additional procedures (e.g., response cost); (7) escape extinction (EE); (8) differential reinforcement of other behavior (DRO); (9) time-out; and (10) time-out with repeated instruction. Table 1 provides descriptions of each intervention specific to the studies included in this review.

Finally, in cases for which both baseline and intervention data were available, data collectors scored intervention effect sizes by calculating the PND (Tarlow & Penland, 2016). Data collectors used WebPlot-Digitizer (Rohatgi, 2015) to determine the values of the data points in the baseline and intervention phases of each published figure to calculate PND. If the intervention used a comparison design (e.g., AB), data collectors took the total number of intervention data points that did not overlap with the highest baseline data point, divided by the total number of intervention data points in the intervention phase, and multiplied by 100%. If the intervention used multiple phases of an intervention (e.g., ABAB), data collectors used the same formula as described above, with the exception that they aggregated data across intervention phases. We used the same categorizations provided by Tarlow and Penland (2016) to classify intervention effect sizes as ineffective if PND was below 50%, questionable if PND was between 50%–70%, effective if PND was between 70%–90%, or highly effective if PND was above 90%.

Results
Demographics and Setting

Table 2 displays case characteristics. Most learners were male (61%; \(n = 19\)), and the average age was 5 years old (range: 2–24 years). Ethnicity was only reported in 5 of 31 cases (16%), with four Caucasian learners (12%) and one Latin American learner (3%). Of 31 cases, 67.7% (\(n = 21\)) of learners were neurotypical, and 32.2% (\(n = 10\)) were diagnosed with a developmental or intellectual disability. Most FAs were conducted in schools (45%; \(n = 14\)) and implemented by behavior therapists (41%; \(n = 13\)). The remaining FAs were conducted in clinics (38%; \(n = 12\)), early education centers (9%; \(n = 3\)), and homes (6%; \(n = 2\)) by caregivers (32%; \(n = 10\)), researchers (19%; \(n = 6\)), teachers (12%; \(n = 4\)), or a combination (i.e., teachers and behavior therapists; 9%; \(n = 3\)). The session implementer was not specified for one case.

Functional Analysis

Overall, most cases included multiple test conditions (96%; \(n = 30\)) using a multielement design (54%; \(n = 17\)) with a contingency reversal (77%; \(n = 24\)) to demonstrate experimental control for the FA. The remaining cases used trial-based (38%; \(n = 12\)), pairwise (25%; \(n = 8\)), reversal (3%; \(n = 1\)), and brief (3%; \(n = 1\)) designs with 54% (\(n = 17\)) of cases having used multiple experimental designs. A portion of cases (22%; \(n = 7\)) used NCR to demonstrate experimental control. Of all cases, the majority used a 5-min session duration (80%; \(n = 25\)), and the average assessment duration was 1 h 28 min (range: 10 min–5 h 48 min).

Outcomes and Procedures
In 30 of 31 cases, implementers examined whether noncompliance was maintained by escape (96%; n = 30). Out of the cases that tested for escape, only half (50%; n = 15) identified noncompliance was maintained by escape.

Existing studies also frequently examined whether noncompliance was maintained by attention (51%; n = 16), with results indicating noncompliance was maintained by attention in half of these cases (50%; n = 8). Procedures for attention test conditions varied across studies. The most common consequence for noncompliance was the delivery of vocal (e.g., reprimands, encouragement) or physical (i.e., physical guidance) attention and continued instructions (75%; n = 12). As an alternative, researchers provided escape without attention contingent on noncompliance in cases using another test condition to demonstrate experimental control (25%; n = 4). The most common consequence for compliance was brief praise and continued instruction (37%; n = 6). As an alternative, researchers programmed escape with no attention (31%; n = 5) or no consequence (25%; n = 4) for noncompliance. One case (3%) did not provide sufficient detail to determine the consequence for noncompliance.

A smaller subset of cases assessed whether noncompliance was maintained by tangible items (29%; n = 9), with nearly all outcomes indicating noncompliance was maintained by tangible items (88%; n = 8). For all cases, tangible test conditions consisted of an instruction to relinquish a preferred item in which compliance resulted in brief praise and no or delayed access to the preferred item, and noncompliance resulted in continued access to the preferred item.

_Eperimental Control Procedures_
The most common arrangement for experimental control demonstrated by a contingency reversal was either the use of one test and one control condition or two test conditions in which the contingencies for compliance and noncompliance were reversed (66%; \( n = 16 \)). For example, Rodriguez et al. (2010) tested for attention and escape functions. In the attention condition, noncompliance resulted in the delivery of attention but no escape from the instruction, whereas compliance resulted in escape but no attention. In the escape condition, the contingencies were reversed such that noncompliance resulted in escape (but no attention), and compliance resulted in attention (but no escape). The remaining contingency reversal cases (33%; \( n = 8 \)) used two test conditions and one control condition, in which the control condition minimized the establishing operation for noncompliance. For example, Wilder et al. (2007a) included tangible, escape, and control conditions. In the tangible condition, noncompliance resulted in access to a highly preferred tangible, and compliance resulted in brief praise and access to low-preferred tangibles. In the escape condition, the contingencies were identical to the tangible condition, except noncompliance resulted in escape from the instruction. In the control condition, compliance resulted in brief praise and access to a highly preferred tangible, and noncompliance resulted in access to low-preferred tangibles where noncompliance was expected to be unlikely.

For NCR procedures, the most common arrangement in the control procedure was providing continuous access to tangibles and attention while providing play instructions throughout the session (85%; \( n = 6 \)). The session therapist ignored noncompliance and blocked other problem behavior (e.g., aggression). In the remaining NCR case, intermittent praise and access to tangibles were provided during the control condition.
Intervention

Intervention information was available for 67% of cases (n = 21). Of these cases, 4% (n = 1) implemented an antecedent-based intervention, 71% (n = 15) implemented a consequence-based intervention, and 23% (n = 5) implemented antecedent- and consequence-based interventions in isolation. Given that the efficacy of intervention procedures may vary based on the function of noncompliance, we analyzed each intervention’s efficacy based on function. Figures 2 and 3 display these data. There was a total of 29 applications of consequence-based interventions across 20 cases. Overall, we found that 86% of applications (n = 25) were classified as effective (37%; n = 11) or highly effective (48%; n = 14) for multiple functions. There was a total of 15 applications of antecedent-based interventions across six cases. In contrast to consequence-based interventions, we found no applications of antecedent-based interventions were effective (0%; n = 0) or highly effective (0%; n = 0) at treating noncompliance, regardless of function. The low number of cases with whom antecedent-based interventions were applied should be considered when interpreting these results.

The most evaluated consequence-based intervention was EE (i.e., guided compliance), with eight applications (27%). Results indicated EE was effective for 75% of applications (n = 6) and highly effective for 25% of applications (n = 2) in which noncompliance was maintained by social positive (i.e., tangibles and attention) and negative (i.e., escape) reinforcement. Likewise, a time-out with repeated instruction procedure was more effective than a time-out without repeated instruction procedure at treating noncompliance maintained by negative reinforcement. Time-out with repeated instruction was highly effective for 100% of applications (n = 4), whereas time-out
without repeated instruction was only effective or highly effective for 50% of applications \( n = 3 \). Given the procedural similarities between “repeated instruction” and EE, it is unsurprising that time-out was more effective when this component was present.

It should be noted, however, that time-out with and without repeated instruction was only evaluated with noncompliance maintained by negative reinforcement. Therefore, the efficacy of time-out to treat noncompliance maintained by social-positive reinforcement remains unknown. It should also be noted that procedural descriptions for time-out were sometimes missing critical details (e.g., the time-out location, the operational definition for appropriate behavior in time-out) and varied across studies included in the current review. In McKerchar and Abby (2012), two applications of time-out without repeated instruction consisted of the researcher removing task materials and turning away from the learner for 15 s, contingent on noncompliance. In Everett et al. (2007), four applications of time-out without repeated instruction consisted of a parent instruction to go to time-out with physical guidance and return to the time-out area as needed until the learner engaged in quiet time for 3–5 s. Following release from time-out, the learner was allowed to interact with the surrounding environment, and the parent delivered a different instruction after a brief delay (i.e., 30 s–1 min). The authors then implemented time-out with repeated instruction which consisted of the same procedures as time-out without repeated instruction, except the parent repeated the same instruction the learner was noncompliant with following release from time-out. Future studies may consider providing additional details for time-out procedures to allow for a more in-depth analysis of its likelihood to address target behaviors.
DRA was efficacious or highly efficacious for all applications (100%; $n = 5$), and DRA with additional procedures (e.g., response cost) was efficacious or highly efficacious for 80% of applications ($n = 4$) when implemented for social-positive functions. In summary, our results indicate that DRA and EE were efficacious at reducing noncompliance across multiple functions, which is consistent with previous literature (Geiger et al., 2010; Lalli et al., 1994; Mitteer et al., 2015; Petscher et al., 2009; Piazza et al., 1996).

**Discussion**

Given that noncompliance is a common concern of caregivers and teachers, the purpose of the current review was to further understand the prevalence of environmental variables that maintain noncompliance and the corresponding efficacy of common interventions. Although noncompliance is often hypothesized to be maintained by escape from demands (Kalb & Loeber, 2003; Lipschultz & Wilder, 2017; Richman & Wacker, 2001), this review found that only half of FA results confirmed an escape function. This finding is consistent with Beavers et al. (2013), who found that 47% of cases of noncompliance were maintained by escape from demands, and Hanley et al. (2003), who found an even lower prevalence with 12% of cases. This low prevalence of escape-maintained noncompliance reported in some literature suggests practitioners should exercise caution when building an intervention around a hypothesis that noncompliance is maintained by escape without confirming this hypothesis via FA. Common objections are that FAs are time-consuming, resource intensive, and impede instructional time (Hanley, 2012). However, our review showed that FAs of noncompliance were
commonly conducted in school settings and were conducted in an average of 90 min. Our findings suggest that the additional time to conduct an FA may outweigh the cost of implementing a nonfunction-based intervention. In addition, although the majority of studies in this review used a multielement design, practitioners could use other methodological designs (e.g., trial-based FA, brief FA) to make these assessments more feasible in various settings.

Another important finding was that no antecedent-based interventions effectively increased compliance in the studies included in the review. This finding is inconsistent with previous studies that have found antecedent-based interventions effective at increasing compliance (e.g., Belfiore et al., 2008; Forehand & Long, 2002; Kraus et al., 2012). The lack of efficacy for antecedent-based interventions in this review might be a product of our review parameters. That is, practitioners may select an antecedent-based strategy as an initial intervention for noncompliance (e.g., lower response effort, requires fewer resources), and if the intervention is effective, there may be no need for an FA of noncompliance. Of course, these potential cases were not considered as they did not meet the inclusion criteria for this study.

Overall, we found that most consequence-based interventions were effective or highly effective at increasing compliance, regardless of function. EE was the most effective at treating noncompliance across functions based on our results. Despite its high efficacy, we recommend practitioners assess noncompliance first and then consider using EE compared to alternative interventions (e.g., DRA) on a case-by-case basis. EE may have social validity concerns, given that it typically requires the implementer to physically guide the learner to comply with instructions contingent on noncompliance.
(Geiger et al., 2010; Vazquez et al., 2018). The learner’s stature, the intensity of the
problem behavior, and the setting can all be barriers to implementing EE (Athens &
Vollmer, 2010; Piazza et al., 1996). The restrictive nature of EE needs to be carefully
considered, as each individual has the right to the most effective yet least restrictive
intervention possible (Behavior Analyst Certification Board, 2020; Van Houten et al.,
1988). Practitioners should conduct a risk–benefit analysis to determine if the temporary
use of EE to increase compliance can be implemented safely and outweighs the risks of
potentially exposing the learner to prolonged implementation of a less effective
intervention or more restrictive procedures later (e.g., restricting participation in certain
activities, seclusion time-outs, expulsion from school). In addition, future research should
focus on developing more effective, socially valid interventions for noncompliance when
EE is not feasible to supplement the existing literature (e.g., Briggs et al., 2019; Chazin et
al., 2022; Lalli et al., 1999) and examine how to fade the use of EE procedures.

This review has several limitations. First, the variety of noncompliance definitions
used across the studies may have influenced the outcomes of this review. In technical
terms, “noncompliance” cannot be considered a behavior in and of itself and is typically
defined as the absence of compliance or engaging in target behaviors following the
instructional presentation. Over half of the included articles defined noncompliance as
failure to initiate or complete an instructed task, typically within a specified amount of
time (e.g., 5 s). Only a few of these articles included a criterion related to problem
behavior (e.g., Call et al., 2004; Ishuin, 2009). The remaining articles provided a response
definition of compliance (e.g., initiating or completing an instructed task within a
specified time) and defined noncompliance simply as the inverse of compliance. We
believe variability among noncompliance definitions is to be expected, given definitions may reflect individualized criteria and goals for behavior change (e.g., the importance of task initiation occurring within 5 s versus 10 s may depend on the type of task or expectations of stakeholders). Given that differences in operational definitions may have inflated or deflated noncompliance rates, we urge readers to interpret the results of this review in light of variability among operational definitions of noncompliance. It may be helpful for future studies examining noncompliance to move toward a universal operational definition to facilitate more in-depth comparisons across studies. We suggest that researchers define noncompliance as engaging in off-task behaviors rather than completing the given instruction within a certain amount of time, and off-task behaviors can be individualized to the student. Researchers could determine the amount of time the student would be expected to comply with the instructions based on their characteristics, such as difficulty level and response effort required.

A second limitation that may have influenced our outcomes is that we were unable to determine for most studies whether noncompliance resulted from a motivational or a skill deficit. Only three of the included studies indicated they selected instructions they observed or received reports from stakeholders that the participant could complete independently. Determining whether noncompliance is a result of a skill deficit rather than a motivational deficit is necessary to design an intervention that is likely to be effective. The intervention components needed to address either of these deficits will likely look quite different. We encourage future studies to describe how the researchers determined noncompliance to be the result of a performance deficit rather than a skill
deficit to support the implementation of an intervention for noncompliance rather than the need for skill acquisition programming.

A third limitation is that we used the author report for the function of noncompliance rather than structured visual analysis (e.g., ongoing visual inspection; Saini et al., 2018). Therefore, it is possible that FA outcomes were differentially determined using various methods. Fourth, given the limited number of cases in this review, our intervention efficacy findings should be interpreted in light of this limitation. For example, DRO was only evaluated for one case of noncompliance. Fifth, procedural integrity information was inconsistently available for studies included in this review, and it remains plausible that suboptimal levels of integrity could have affected intervention efficacy. We encourage future studies of noncompliance to include procedural integrity data. Finally, our search parameters and inclusion criteria likely resulted in a slightly different subset of published studies from Beavers et al. (2013), which limits the ability to compare outcomes across their study and the current one.

In summary, we conducted a systematic review of FAs of noncompliance to determine the prevalence of environmental variables that commonly maintain noncompliance and determine the efficacy of function-based interventions to decrease noncompliance. Despite the common hypothesis that noncompliance is commonly maintained by escape from demands, this was only true for half of the cases identified in this review, and consequence-based interventions were more efficacious than antecedent-based interventions at increasing compliance. Conducting an FA of noncompliance may be valuable when compliance does not improve with less-intensive interventions (e.g., antecedent-based) or significantly affects the learner’s day-to-day activities. Fortunately,
this review found FAs to be relatively time-efficient, consistent with previous findings (e.g., Saini et al., 2020). Future studies implementing an FA of noncompliance, such as the ones reviewed here, would further this line of research by investigating the most efficacious function-based interventions for learner noncompliance.
References marked with an asterisk (*) indicate studies included in the literature review.


https://doi.org/10.1901/jaba.1985.18-111

https://www.cdc.gov/parents/essentials/timeout/steps.html


https://doi.org/10.1901/jaba.2003.36-147


https://doi.org/10.1177/10983007050070040401


https://doi.org/10.1037/h0100663


https://doi.org/10.1901/jaba.2012.45-131


https://doi.org/10.1177/1098300715577428


Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., &

acceptability and preference for behavioral interventions for feeding problems.
*Behavior Modification, 43*(2), 273–287.
https://doi.org/10.1177/0145445517751435

reduce noncompliance among preschool children. *Behavioral Interventions:
Theory & Practice in Residential & Community-Based Clinical Programs, 21*(4),
265–272. https://doi.org/10.1002/bin.222

*Wilder, D. A., Harris, C., Reagan, R., & Rasey, A. (2007a). Functional analysis and
treatment of noncompliance by preschool children. *Journal of Applied Behavior
Analysis, 40*(1), 173–177. https://doi.org/10.1901/jaba.2007.44-06

analysis of antecedent interventions on preschoolers’ compliance. *Journal of

evaluation of antecedent interventions on compliance: The effects of rationales to
increase compliance among preschoolers. *Journal of Applied Behavior Analysis,
### Table 1

*Intervention Descriptions*

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Intervention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antecedent-Based</td>
<td>NCR</td>
<td>Delivery of preferred edibles during instruction delivery</td>
</tr>
<tr>
<td></td>
<td>High-P</td>
<td>Delivery of 3 high-p instructions before target instruction</td>
</tr>
<tr>
<td></td>
<td>Warning</td>
<td>Delivery of 1-min warning of end or start of next activity</td>
</tr>
<tr>
<td></td>
<td>Rationales</td>
<td>Delivery of 1 of 3 rationales with each instruction</td>
</tr>
<tr>
<td>Consequence-Based</td>
<td>DRA</td>
<td>Reinforcement in the form of edibles or attention contingent on compliance</td>
</tr>
<tr>
<td></td>
<td>DRA + Additional Procedures</td>
<td>Positive reinforcement contingent on compliance plus tokens, TO was implemented contingent on disruptive behavior, or therapists removed small portion of previously earned edibles contingent on noncompliance (RC)</td>
</tr>
<tr>
<td></td>
<td>EE</td>
<td>Noncompliance resulted in physical guidance</td>
</tr>
<tr>
<td></td>
<td>DRO</td>
<td>Absence of noncompliance resulted in attention delivery</td>
</tr>
<tr>
<td></td>
<td>TO</td>
<td>Noncompliance resulted in TO</td>
</tr>
<tr>
<td></td>
<td>TO + Repeated Instruction</td>
<td>Noncompliance resulted in TO and the same instruction repeated following TO</td>
</tr>
</tbody>
</table>

*Note.* DRA = Differential reinforcement of alternative behavior; TO = Time out; RC = Response cost; EE = Escape extinction; DRO = Differential reinforcement of other behavior; NCR = Noncontingent reinforcement; High-P = High-probability instructional sequence.
### Table 2

**Case Characteristics**

<table>
<thead>
<tr>
<th>Source</th>
<th>Learner</th>
<th>Age</th>
<th>Gender</th>
<th>Diagnosis</th>
<th>Function</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call et al., 2004</td>
<td>Moira</td>
<td>6</td>
<td>NS</td>
<td>-</td>
<td>Esc</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Nick</td>
<td>7</td>
<td>NS</td>
<td>-</td>
<td>Esc</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Daisy</td>
<td>4</td>
<td>NS</td>
<td>-</td>
<td>Esc, Div Att</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Andy</td>
<td>6</td>
<td>NS</td>
<td>-</td>
<td>Esc</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Zach</td>
<td>8</td>
<td>NS</td>
<td>-</td>
<td>Esc</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Jacob</td>
<td>5</td>
<td>NS</td>
<td>-</td>
<td>Esc</td>
<td>-</td>
</tr>
<tr>
<td>Everett et al., 2007</td>
<td>Isaac</td>
<td>4</td>
<td>M</td>
<td>-</td>
<td>Esc</td>
<td>TO, TO + RI</td>
</tr>
<tr>
<td></td>
<td>Nick</td>
<td>4</td>
<td>M</td>
<td>-</td>
<td>Esc</td>
<td>TO, TO + RI</td>
</tr>
<tr>
<td></td>
<td>Zeke</td>
<td>5</td>
<td>M</td>
<td>-</td>
<td>Esc</td>
<td>TO, TO + RI</td>
</tr>
<tr>
<td></td>
<td>Tina</td>
<td>5</td>
<td>F</td>
<td>-</td>
<td>Esc</td>
<td>TO, TO + RI</td>
</tr>
<tr>
<td>Ishuin, 2009</td>
<td>Michael</td>
<td>4</td>
<td>M</td>
<td>-</td>
<td>Att</td>
<td>DRO</td>
</tr>
<tr>
<td>Kern et al., 2002</td>
<td>Christina</td>
<td>24</td>
<td>F</td>
<td>ID</td>
<td>Esc</td>
<td>EE</td>
</tr>
<tr>
<td></td>
<td>Joel</td>
<td>12</td>
<td>M</td>
<td>ID</td>
<td>Att</td>
<td>EE</td>
</tr>
<tr>
<td>Lloyd et al., 2016</td>
<td>Juan</td>
<td>8</td>
<td>M</td>
<td>ASD, ID</td>
<td>Esc + Tang</td>
<td>-</td>
</tr>
<tr>
<td>Majdalany et al., 2017</td>
<td>Carter</td>
<td>4</td>
<td>NS</td>
<td>ULD</td>
<td>Tang</td>
<td>DRA + AP</td>
</tr>
<tr>
<td>McKerchar &amp; Abby, 2012</td>
<td>Jeane</td>
<td>4</td>
<td>F</td>
<td>-</td>
<td>Esc</td>
<td>TO, EE</td>
</tr>
<tr>
<td></td>
<td>Jayme</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Esc</td>
<td>TO, EE</td>
</tr>
<tr>
<td>Noell et al., 2001</td>
<td>Andrew</td>
<td>5</td>
<td>M</td>
<td>DSLD</td>
<td>Att</td>
<td>DRA, DRA + AP</td>
</tr>
<tr>
<td></td>
<td>Sam</td>
<td>3</td>
<td>M</td>
<td>DSLD</td>
<td>Att</td>
<td>DRA</td>
</tr>
<tr>
<td></td>
<td>Elaine</td>
<td>5</td>
<td>F</td>
<td>DSLD</td>
<td>Att</td>
<td>DRA</td>
</tr>
<tr>
<td>Rodriguez et al., 2010</td>
<td>Sue</td>
<td>2</td>
<td>F</td>
<td>-</td>
<td>Att</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Lee</td>
<td>4</td>
<td>M</td>
<td>-</td>
<td>Att</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Ben</td>
<td>4</td>
<td>M</td>
<td>DS</td>
<td>Att</td>
<td>-</td>
</tr>
<tr>
<td>Wilder et al., 2007a</td>
<td>Fred</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Tang</td>
<td>DRA + AP</td>
</tr>
<tr>
<td></td>
<td>Sam</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Tang</td>
<td>DRA + AP</td>
</tr>
<tr>
<td>Wilder et al., 2007b</td>
<td>Eddie</td>
<td>2</td>
<td>M</td>
<td>-</td>
<td>Esc</td>
<td>NCR, W, HP, EE</td>
</tr>
<tr>
<td></td>
<td>Ricky</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Tang</td>
<td>NCR, W, HP, EE</td>
</tr>
<tr>
<td></td>
<td>Timmy</td>
<td>3</td>
<td>M</td>
<td>Fragile X</td>
<td>Tang, Esc</td>
<td>NCR, W, HP</td>
</tr>
<tr>
<td>Wilder et al., 2010</td>
<td>Ricky</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Tang</td>
<td>R, EE</td>
</tr>
<tr>
<td></td>
<td>Ian</td>
<td>3</td>
<td>M</td>
<td>-</td>
<td>Tang</td>
<td>R, DRA, DRA + AP</td>
</tr>
<tr>
<td></td>
<td>Andy</td>
<td>3</td>
<td>M</td>
<td>ASD</td>
<td>Tang</td>
<td>R, EE, DRA</td>
</tr>
</tbody>
</table>

*Note.* F = Female; M = Male; - = None; Esc = Escape; Div Att = Diverted attention; Att = Attention; Esc + Tang = Synthesized escape and tangible; Tang = Tangible; TO = Time-out; TO + RI = Time-out with repeated instruction; EE = Escape extinction; DRA+AP = DRA with additional procedures; W = Warnings; HP = High-probability instructional sequence; ID = Intellectual disorder; ASD = Autism spectrum disorder; ULD = Unspecified language disorder; DSLD = Delayed speech and language development; DS = Down syndrome.
**Figure 1**

*PRISMA Flow Diagram*

- **Identification**
  - Studies identified through PsycINFO search \((n = 2,047)\)
  - Total after duplicates removed \((n = 2,030)\)
  - Studies eligible for title/abstract screening \((n = 2,030)\)
  - Studies eligible for full-text review \((n = 20)\)
  - Studies met inclusion criteria \((n = 12)\)
  - Additional studies identified \((n = 0)\)
  - Cases from included studies \((n = 38)\)
  - Studies identified through Google Scholar \((n = 21)\)
  - Studies that met one or more exclusion criteria \((n = 2,010)\)
  - Studies from reference lists of included articles \((n = 100)\)
  - Studies from reference lists after duplicates removed eligible for screening \((n = 98)\)
  - Cases that met one or more exclusion criteria \((n = 7)\)

- **Included**
  - Studies included \((n = 12)\)
  - Cases included \((n = 31)\)
Figure 2

Antecedent-Based Intervention Efficacy by Function

Note. Ineffective (PND < 50%); Questionable (PND 50–70%); Effective (PND 70–90%); Very Effective (PND > 90%). NCR = Noncontingent reinforcement. High-P = High probability instructional sequence. Absence of bars indicates zero cases.
Figure 3

Consequence-Based Intervention Efficacy by Function

Note. Ineffective (PND < 50%); Questionable (PND 50–70%); Effective (PND 70–90%); Very Effective (PND > 90%). DRA = Differential Reinforcement of Alternative Behavior; DRA + AP = DRA with additional procedures; EE = Escape Extinction; DRO = Differential Reinforcement of Other Behavior; TO = Time Out; TO + RI = TO with repeated instruction. Absence of bars indicates zero cases.
SPRINGER NATURE LICENSE

TERMS AND CONDITIONS

Sep 25, 2023

This Agreement between Utah State University -- Alyssa Hurd ("You") and Springer Nature ("Springer Nature") consists of your license details and the terms and conditions provided by Springer Nature and Copyright Clearance Center.

License Number    5636050855386
License date     Sep 25, 2023
Licensed Content Publisher   Springer Nature
Licensed Content Publication   Education & Treatment of Children
Licensed Content Title                                    A Systematic Review on Functional Analysis of Noncompliance
Licensed Content Author   Alyssa M. Hurd et al
Licensed Content Date   Mar 28, 2023
Type of Use     Thesis/Dissertation
Requestor type    academic/university or research institute
Format      print and electronic
Portion      full article/chapter
Will you be translating?   no
Circulation/distribution   20000 - 49999
Author of this Springer Nature content yes
Title                                                                A Systematic Review on Functional Analysis of Noncompliance
Institution name    Utah State University
Expected presentation date Oct 2023
Requestor Location    Utah State University
2810 Old Main Hill
LOGAN, UT 84322
United States
Attn: Utah State University

Total      0.00 USD

Terms and Conditions

**Springer Nature Customer Service Centre GmbH Terms and Conditions**

The following terms and conditions ("Terms and Conditions") together with the terms specified in your [RightsLink] constitute the License ("License") between you as Licensee and Springer Nature Customer Service Centre GmbH as Licensor. By clicking 'accept' and completing the transaction for your use of the material ("Licensed Material"), you confirm your acceptance of and obligation to be bound by these Terms and Conditions.

1. **Grant and Scope of License**

1. 1. The Licensor grants you a personal, non-exclusive, non-transferable, non-sublicensable, revocable, world-wide License to reproduce, distribute, communicate to the public, make available, broadcast, electronically transmit or create derivative works using the Licensed Material for the purpose(s) specified in your RightsLink Licence Details only. Licenses are granted for the specific use requested in the order and for no other use, subject to these Terms and Conditions. You acknowledge and agree that the rights granted to you under this License do not include the right to modify, edit, translate, include in collective works, or create derivative works of the Licensed Material in whole or in part unless expressly stated in your RightsLink Licence Details. You may use the Licensed Material only as permitted under this Agreement and will not reproduce, distribute, display, perform, or otherwise use or exploit any Licensed Material in any way, in whole or in part, except as expressly permitted by this License.

1. 2. You may only use the Licensed Content in the manner and to the extent permitted by these Terms and Conditions, by your RightsLink Licence Details and by any applicable laws.
1. 3. A separate license may be required for any additional use of the Licensed Material, e.g. where a license has been purchased for print use only, separate permission must be obtained for electronic re-use. Similarly, a License is only valid in the language selected and does not apply for editions in other languages unless additional translation rights have been granted separately in the License.

1. 4. Any content within the Licensed Material that is owned by third parties is expressly excluded from the License.

1. 5. Rights for additional reuses such as custom editions, computer/mobile applications, film or TV reuses and/or any other derivative rights requests require additional permission and may be subject to an additional fee. Please apply to journalpermissions@springernature.com or bookpermissions@springernature.com for these rights.

2. **Reservation of Rights**

Licensor reserves all rights not expressly granted to you under this License. You acknowledge and agree that nothing in this License limits or restricts Licensor's rights in or use of the Licensed Material in any way. Neither this License, nor any act, omission, or statement by Licensor or you, conveys any ownership right to you in any Licensed Material, or to any element or portion thereof. As between Licensor and you, Licensor owns and retains all right, title, and interest in and to the Licensed Material subject to the license granted in Section 1.1. Your permission to use the Licensed Material is expressly conditioned on you not impairing Licensor's or the applicable copyright owner's rights in the Licensed Material in any way.

3. **Restrictions on use**

3. 1. Minor editing privileges are allowed for adaptations for stylistic purposes or formatting purposes provided such alterations do not alter the original meaning or intention of the Licensed Material and the new figure(s) are still accurate and representative of the Licensed Material. Any other changes including but not limited to, cropping, adapting, and/or omitting material that affect the meaning, intention or moral rights of the author(s) are strictly prohibited.

3. 2. You must not use any Licensed Material as part of any design or trademark.

3. 3. Licensed Material may be used in Open Access Publications (OAP), but any such reuse must include a clear acknowledgment of this permission visible at the same time as the figures/tables/illustration or abstract and which must indicate that the Licensed Material is not part of the governing OA license but has been reproduced with permission. This may be indicated according to any standard
referencing system but must include at a minimum 'Book/Journal title, Author, Journal Name (if applicable), Volume (if applicable), Publisher, Year, reproduced with permission from SNCSC'.

4. **STM Permission Guidelines**

4. 1. An alternative scope of license may apply to signatories of the STM Permissions Guidelines ("STM PG") as amended from time to time and made available at [https://www.stm-assoc.org/intellectual-property/permissions/permissions-guidelines/](https://www.stm-assoc.org/intellectual-property/permissions/permissions-guidelines/).

4. 2. For content reuse requests that qualify for permission under the STM PG, and which may be updated from time to time, the STM PG supersede the terms and conditions contained in this License.

4. 3. If a License has been granted under the STM PG, but the STM PG no longer apply at the time of publication, further permission must be sought from the Rightsholder. Contact journalpermissions@springernature.com or bookpermissions@springernature.com for these rights.

5. **Duration of License**

5. 1. Unless otherwise indicated on your License, a License is valid from the date of purchase ("License Date") until the end of the relevant period in the below table:

<table>
<thead>
<tr>
<th>Reuse in a Medical Communications Project</th>
<th>Reuse up to Distribution or Time Period Indicated in License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reuse in a Dissertation/Thesis</td>
<td>Lifetime of Thesis</td>
</tr>
<tr>
<td>Reuse in a Journal/Magazine</td>
<td>Lifetime of Journal/Magazine</td>
</tr>
<tr>
<td>Reuse in a Book/Textbook</td>
<td>Lifetime of Edition</td>
</tr>
<tr>
<td>Reuse on a Website</td>
<td>1 year unless otherwise specified in the License</td>
</tr>
<tr>
<td>Reuse in a Presentation/Slide Kit/Poster</td>
<td>Lifetime of Presentation/Slide Kit/Poster. Note: publication whether electronic or in print of presentation/slide kit/poster may require further permission.</td>
</tr>
<tr>
<td>Reuse in conference proceedings</td>
<td>Lifetime of conference proceedings</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Reuse in an annual report</td>
<td>Lifetime of annual report</td>
</tr>
<tr>
<td>Reuse in training/CME materials</td>
<td>Reuse up to distribution or time period indicated in License</td>
</tr>
<tr>
<td>Reuse in newsmedia</td>
<td>Lifetime of newsmedia</td>
</tr>
<tr>
<td>Reuse in coursepack/classroom materials</td>
<td>Reuse up to distribution and/or time period indicated in license</td>
</tr>
</tbody>
</table>

6. Acknowledgement

6.1. The Licensor's permission must be acknowledged next to the Licensed Material in print. In electronic form, this acknowledgement must be visible at the same time as the figures/tables/illustrations or abstract and must be hyperlinked to the journal/book's homepage.

6.2. Acknowledgement may be provided according to any standard referencing system and at a minimum should include "Author, Article/Book Title, Journal name/Book imprint, volume, page number, year, Springer Nature".

7. Reuse in a dissertation or thesis

7.1. Where 'reuse in a dissertation/thesis' has been selected, the following terms apply: Print rights of the Version of Record are provided for; electronic rights for use only on institutional repository as defined by the Sherpa guideline (www.sherpa.ac.uk/romeo/) and only up to what is required by the awarding institution.

7.2. For theses published under an ISBN or ISSN, separate permission is required. Please contact journalpermissions@springernature.com or bookpermissions@springernature.com for these rights.

7.3. Authors must properly cite the published manuscript in their thesis according to current citation standards and include the following acknowledgement: 'Reproduced with permission from Springer Nature'.

8. License Fee
You must pay the fee set forth in the License Agreement (the "License Fees"). All amounts payable by you under this License are exclusive of any sales, use, withholding, value added or similar taxes, government fees or levies or other assessments. Collection and/or remittance of such taxes to the relevant tax authority shall be the responsibility of the party who has the legal obligation to do so.

9. Warranty

9.1. The Licensor warrants that it has, to the best of its knowledge, the rights to license reuse of the Licensed Material. You are solely responsible for ensuring that the material you wish to license is original to the Licensor and does not carry the copyright of another entity or third party (as credited in the published version). If the credit line on any part of the Licensed Material indicates that it was reprinted or adapted with permission from another source, then you should seek additional permission from that source to reuse the material.

9.2. EXCEPT FOR THE EXPRESS WARRANTY STATED HEREIN AND TO THE EXTENT PERMITTED BY APPLICABLE LAW, LICENSOR PROVIDES THE LICENSED MATERIAL "AS IS" AND MAKES NO OTHER REPRESENTATION OR WARRANTY. LICENSOR EXPRESSLY DISCLAIMS ANY LIABILITY FOR ANY CLAIM ARISING FROM OR OUT OF THE CONTENT, INCLUDING BUT NOT LIMITED TO ANY ERRORS, INACCURACIES, OMISSIONS, OR DEFECTS CONTAINED THEREIN, AND ANY IMPLIED OR EXPRESS WARRANTY AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL LICENSOR BE LIABLE TO YOU OR ANY OTHER PARTY OR ANY OTHER PERSON OR FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, PUNITIVE, OR EXEMPLARY DAMAGES, HOWEVER CAUSED, ARISING OUT OF OR IN CONNECTION WITH THE DOWNLOADING, VIEWING OR USE OF THE LICENSED MATERIAL REGARDLESS OF THE FORM OF ACTION, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, INFRINGEMENT OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, DAMAGES BASED ON LOSS OF PROFITS, DATA, FILES, USE, BUSINESS OPPORTUNITY OR CLAIMS OF THIRD PARTIES), AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION APPLIES NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY PROVIDED HEREIN.

10. Termination and Cancellation
10. 1. The License and all rights granted hereunder will continue until the end of the applicable period shown in Clause 5.1 above. Thereafter, this license will be terminated and all rights granted hereunder will cease.

10. 2. Licensor reserves the right to terminate the License in the event that payment is not received in full or if you breach the terms of this License.

11. General

11. 1. The License and the rights and obligations of the parties hereto shall be construed, interpreted and determined in accordance with the laws of the Federal Republic of Germany without reference to the stipulations of the CISG (United Nations Convention on Contracts for the International Sale of Goods) or to Germany’s choice-of-law principle.

11. 2. The parties acknowledge and agree that any controversies and disputes arising out of this License shall be decided exclusively by the courts of or having jurisdiction for Heidelberg, Germany, as far as legally permissible.

11. 3. This License is solely for Licensor's and Licensee's benefit. It is not for the benefit of any other person or entity.

Questions? For questions on Copyright Clearance Center accounts or website issues please contact springernaturesupport@copyright.com or +1-855-239-3415 (toll free in the US) or +1-978-646-2777. For questions on Springer Nature licensing please visit https://www.springernature.com/gp/partners/rights-permissions-third-party-distribution

Other Conditions:

Version 1.4 - Dec 2022

Questions? customercare@copyright.com